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CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE
Editor

Volume 34 New York, January, 1927 Number 1

NATIONAL ASPECTS *of the* CHEMICAL INDUSTRY

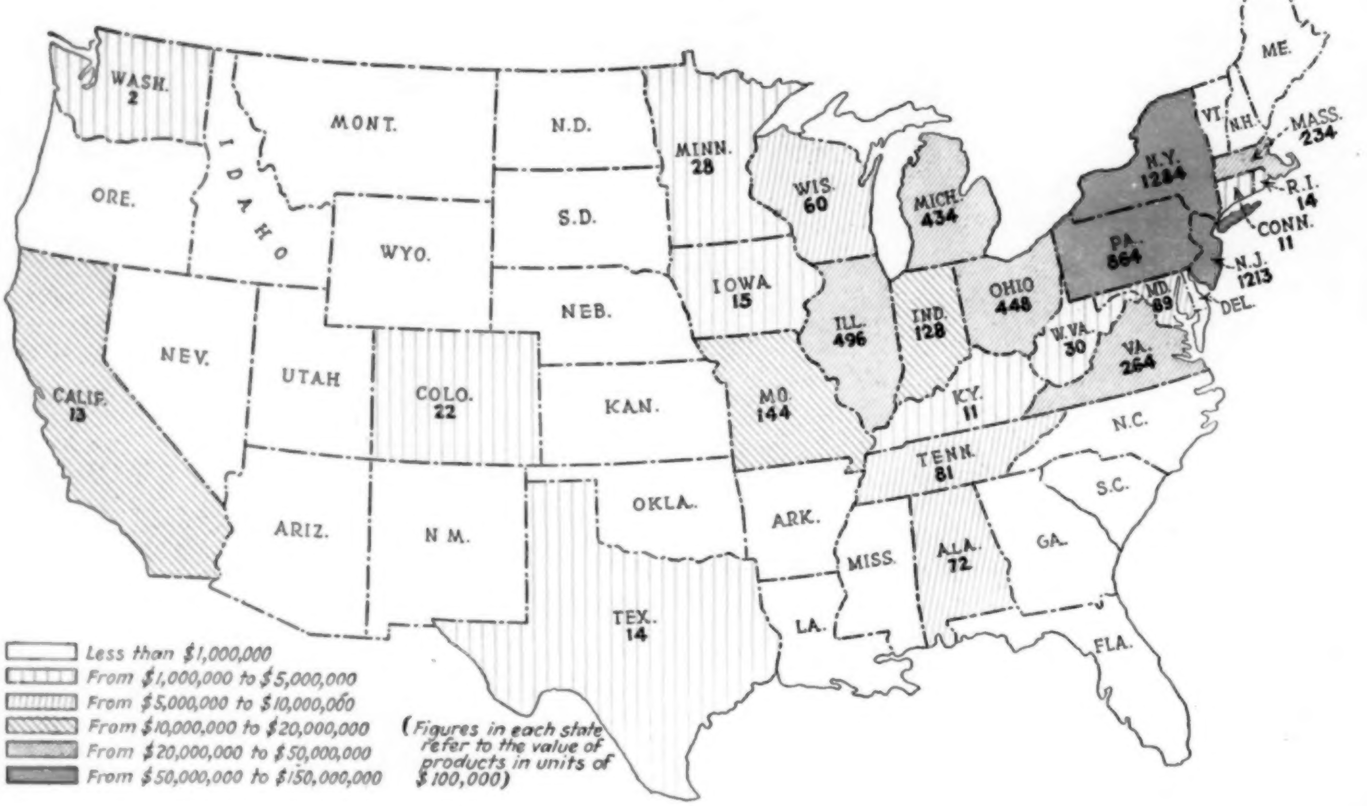
WITH forecasts of general business in 1927 unanimous in their conservative optimism, with freedom from marked fluctuations in production and consumption, with increasing efficiency and a better grasp of the principles of good management, the chemical industry of the United States can reasonably expect to enjoy its share of national prosperity.

Believing with Mr. Hoover that "statistics are not mental exercises" but are "the first step toward right decisions," *Chem. & Met.* offers its fourth annual statistical summary of the chemical industry. Although the preparation of the data has indeed been mental exercise for the editors, their aim will fall far short of expectation if the facts presented are not used by the industry to determine decisions on future production and distribution.

In addition to the statistical studies there is launched in this number the first attempt at a nation-wide survey of factors likely to influence the future growth and expansion of chemical producing and consuming industries. Where are the present centers of chemical manufacture? Where are the points of consumption? How economically do these coincide? Where shall new chemical industries be located? And where shall new chemical consuming industries most logically be established? Finally, what and where are the raw materials?

An attempt is made in the following pages to give basic information that will suggest answers to these questions and lead to national expansion along logical lines of opportunity and need. Through the generous cooperation of contributors a dozen areas have already been studied and described. Similar articles are in preparation covering the remainder of the country and will be presented in succeeding numbers throughout the year. The completed survey will emphasize the national aspects of the chemical industry in a manner not hitherto available.

A Basis for the FUTURE DEVEL[OP...]



National PRODUCTION *of Chemicals*

[Value of Output Reported by the Census of Manufactures (1923) for the following Industries: Acids; Nitrogen Compounds; Sodium Compounds; Potassium Compounds; Aluminum Compounds; Bleaching Compounds; Coal-tar Products, Compressed and Liquefied Gases; and Miscellaneous Chemicals.]

THE key position of the chemical industries in the industrial structure of the United States is easily demonstrated. Directly or indirectly sulphuric acid enters into the manufacture of practically every commodity of commerce. Many other heavy chemicals are of almost as broad distribution. It is natural, therefore, that in its early history the chemical industries should have closely paralleled the development of industry as a whole. But lately certain tendencies have become evident among consuming industries that have not yet been reflected to their full extent in the development of the chemical producing industries.

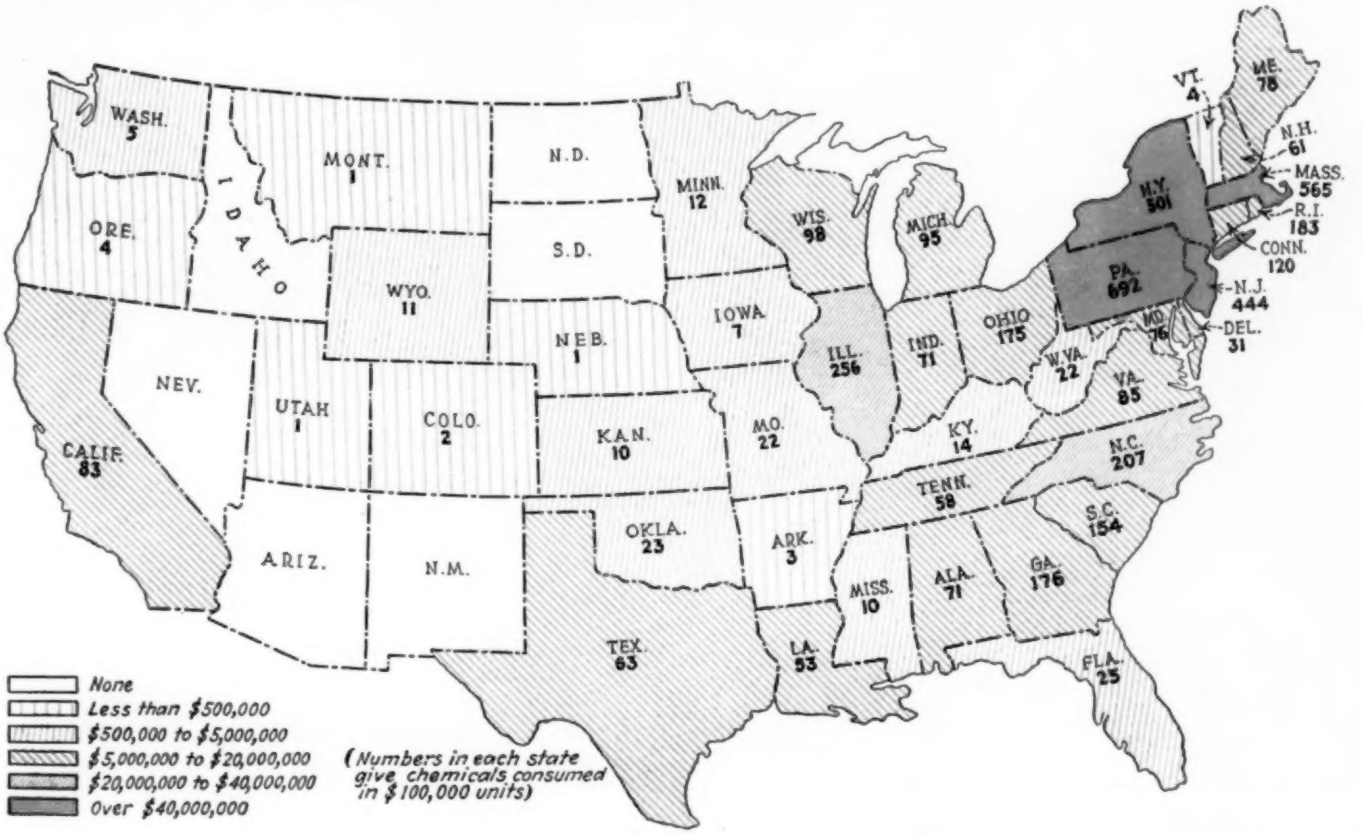
A decentralizing influence has been at work, particularly since the War, and many established centers of certain industries have felt the effect of an industrial migration brought on by excessive costs of transporting raw materials and manufactured products, competitive bidding for labor and other of the disadvantages of a congested industrial district. Manufacturing is taking on a national character and consequently the market for chemicals is broadening to cover practically the whole of the United States.

THE existing relation between the chemical producing and consuming industries is clearly shown by the accompanying maps and the data on which they are based. Chemical producing

CHEMICAL PRODUCTION AND CON[SUM...]

State	No. of Chemical Producing Plants	Census Reports Value of Output of Chemical Producing Industries*	Estimated Purchases of Chemicals by Ten Consuming Industries**	Difference +Excess Production; —Excess Consumption
Alabama	8	$7,153,875	$7,092,000	+62,000
Arizona	...	....	....	....
Arkansas	...	....	345,000	—345,000
California	49	13,045,124	8,327,000	+4 718,000
Colorado	7	2,153,431	214,000	+1,839,000
Connecticut	4	1,137,205	11,961,000	—10,824,000
Delaware	...	(Not shown)	3,050,000	....
Florida	...	....	2,450,000	—2,450,000
Georgia	7	930,343	17,555,000	—16,625,000
Idaho	...	....	....	....
Illinois	45	49,578,266	25,640,000	+23,938,000
Indiana	16	12,794,810	7.124,000	+5,670,000
Iowa	7	1,516,939	692,000	+824.000
Kansas	...	....	1,027,000	—1,027,000
Kentucky	4	1,094,157	1,377,000	—283,000
Louisiana	6	856,838	5,252,000	—4,395,000
Maine	...	....	7,780,000	—7,780,000
Maryland	11	8,926,573	7,602,000	+1,324,000
Massachusetts	36	23,351,305	56,450,000	—33,099,000
Michigan	21	43,379,853	9,479,000	33,900,000
Minnesota	12	2,832,539	1,217,000	+1,615,000
Mississippi	...	....	1,000,000	—1,000,000
Missouri	22	14,467,609	2,214,000	+12,253,000
Montana	...	....	37,000	—37,000
Nebraska	4	714,269	73,000	+641,000
Nevada	...	....	....	....
New Hampshire	...	(Not shown)	6,115,000	....

OPMENT *of the Chemical Industries*



National CONSUMPTION *of Chemicals*

[Estimated Purchases of Chemicals Based on Census of Manufactures (1923) Reports for Chemicals, Soap, Paint and Varnish, Iron and Steel, Petroleum Refining, Pulp and Paper, Leather, Sugar Refining, Fertilizer Manufacture and Dyeing and Finishing of Textiles.]

SUMPTION IN THE UNITED STATES

State	No. of Chemical Producing Plants	Census Reports Value of Output of Chemical Producing Industries*	Estimated Purchases of Chemicals by Ten Consuming Industries**	Difference +Excess Production; —Excess Consumption
New Jersey....	125	$121,301,321	$44,413,000	+76,884,000
New Mexico...	...	....	....	....
New York.....	106	128,376,073	50,173,000	+78,302,000
North Carolina.	...	....	20,741,000	—20,741,000
North Dakota..	...	....	....	....
Ohio..........	60	44,761,125	17,515,000	+27,246,000
Oklahoma......	...	....	2,320,000	—2,320,000
Oregon........	...	....	395,000	—395,000
Pennsylvania...	83	86,409,899	69,329,000	+17,181,000
Rhode Island...	6	1,437,846	18,307,000	—16,870,000
South Carolina.	...	....	15,360,000	—15,360,000
South Dakota..	...	....	....	....
Tennessee......	13	8,067,697	5,752,000	+2,315,000
Texas.........	9	1,403,992	6,266,000	—4,862,000
Utah..........	3	164,187	62,000	—102,000
Vermont	...	....	370,000	—370,000
Virginia.......	17	26,426,524	8,486,000	+17,940,000
Washington....	10	2,009,439	525,000	+1,484,000
West Virginia..	11	2,995,166	2,200,000	+795,000
Wisconsin.....	11	6,036,824	9,837,000	—3,800,000
Wyoming......	...	....	1,130,000	—1,130,000
Total.....	...	$613,323,228	$457,154,000	+$156,169,000

* Including the following industries as set up in the Census classifications: Acids; Nitrogen Compounds; Sodium Compounds; Potassium Compounds; Aluminum Compounds; Bleaching Compounds; Coaltar Products; Plastics; Compressed and Liquefied Gases; and Miscellaneous Chemicals.

** Estimates based on Census Reports for Chemicals: Soap; Paint and Varnish; Iron and Steel; Petroleum Refining; Pulp and Paper; Leather; Sugar; Fertilizers; and Textiles.

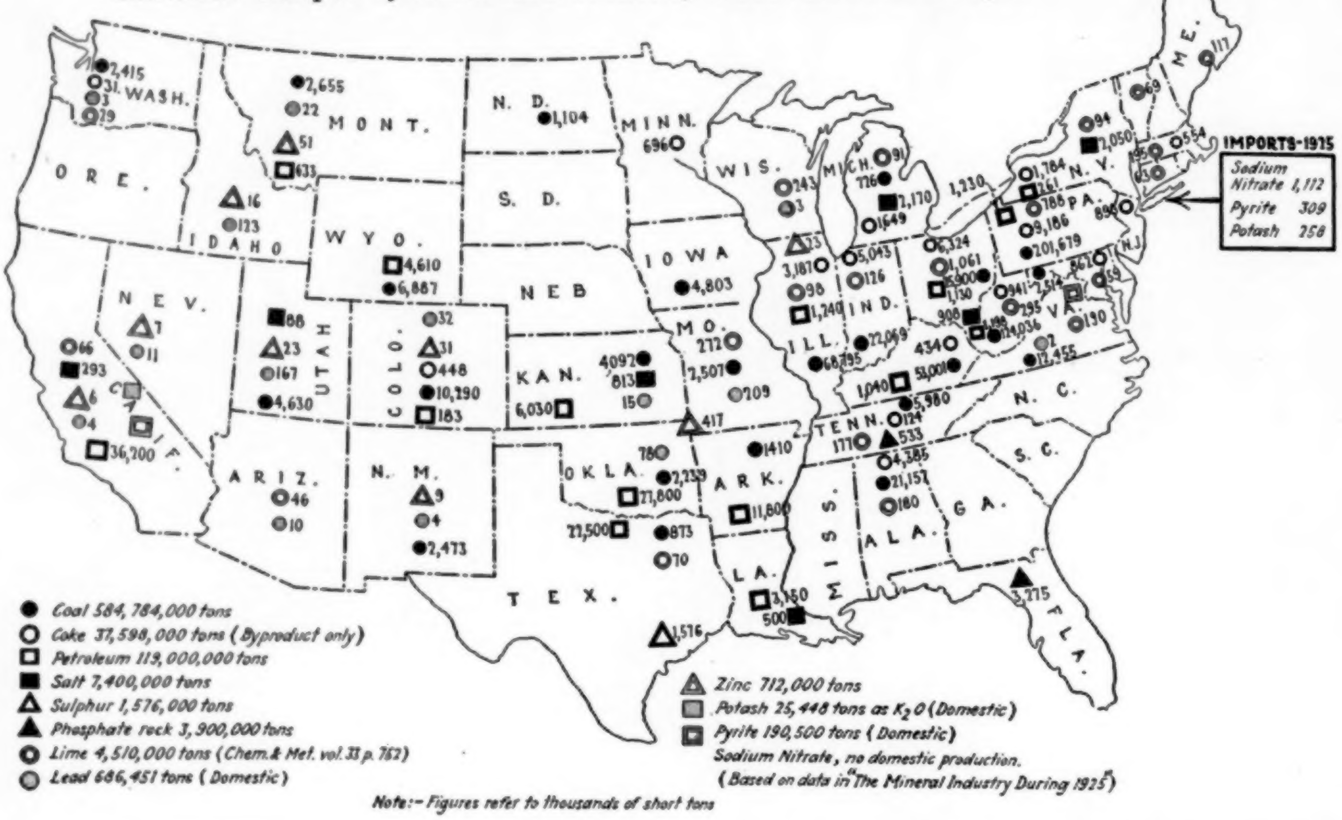
plants are largely concentrated within the limited area consisting of New York, New Jersey and Pennsylvania, with a proportionate development in such long established industrial centers as Chicago, Cleveland and Detroit. Northern New England, the South and the West are sparsely represented.

But in the opposite map of the consuming industries, certain important contrasts are to be seen. New England, the South and the Southwest stand out as substantial markets for chemicals. And in the more congested areas we find production in large excess of consumption—a condition that is doubtless a contributing cause of the sometimes destructive competition that exists between chemical producers in these highly developed centers.

A FURTHER and significant commentary is to be drawn from the maps on the page which follows this. Raw materials for the chemical engineering industries are widely distributed—but are most abundant in the identical areas of the South and West that are now lacking in chemical producing industries.

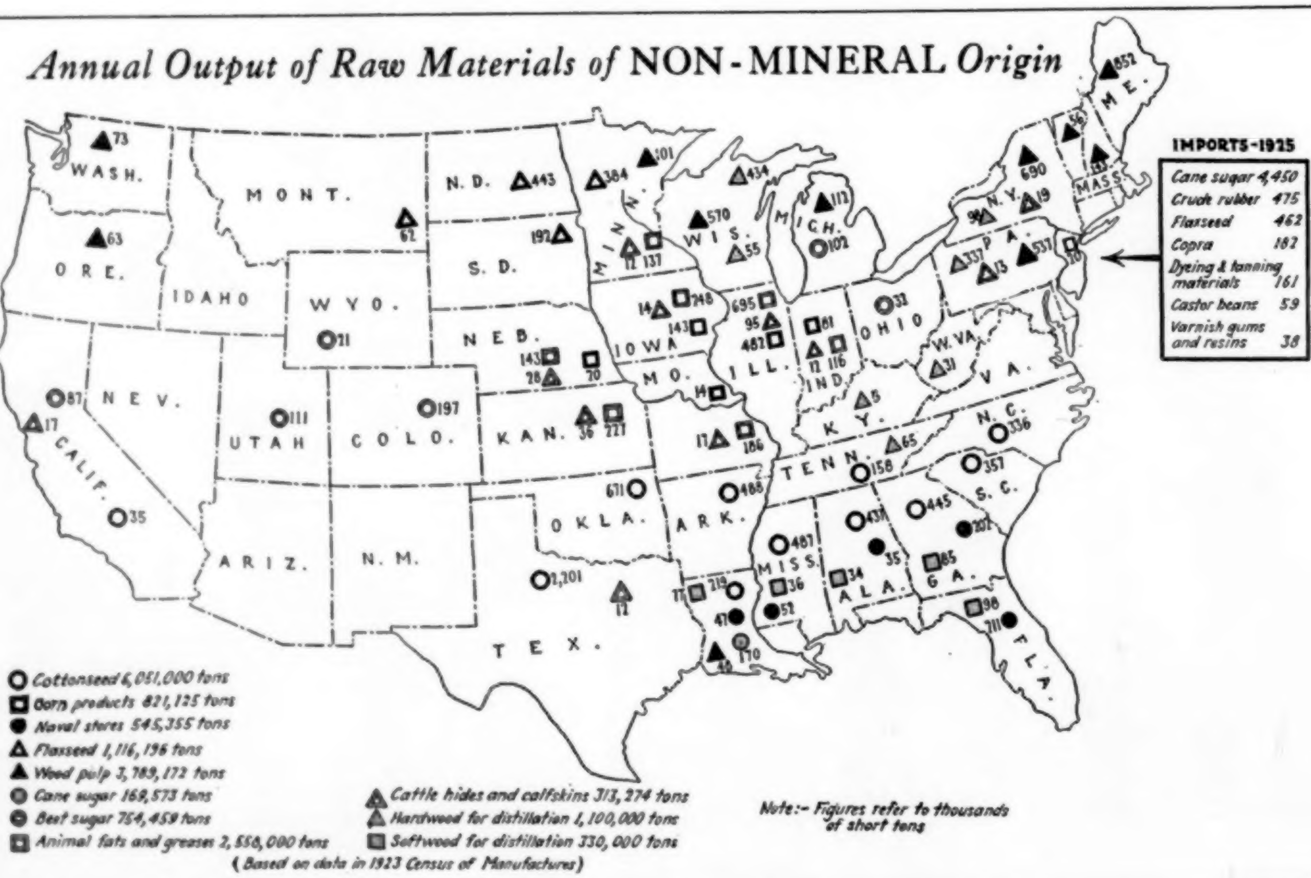
If the consumer is to be served most effectively, the future development of the chemical industries must be based on a more logical relation to these newer industrial markets and their tributary raw material resources.

Annual Output of Raw Materials of MINERAL Origin



Where the Chemical Engineering Industries Get Their Raw Materials

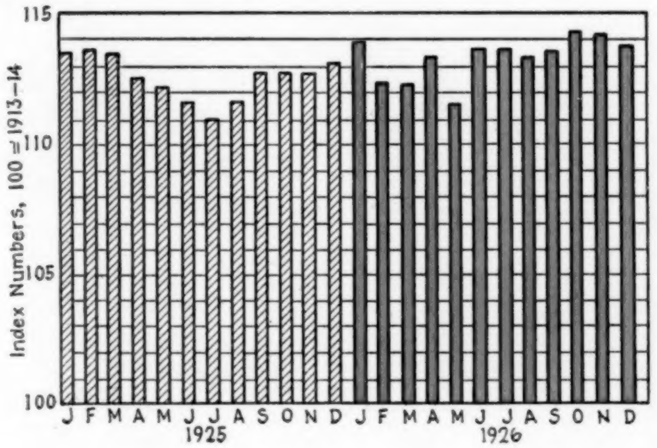
Annual Output of Raw Materials of NON-MINERAL Origin



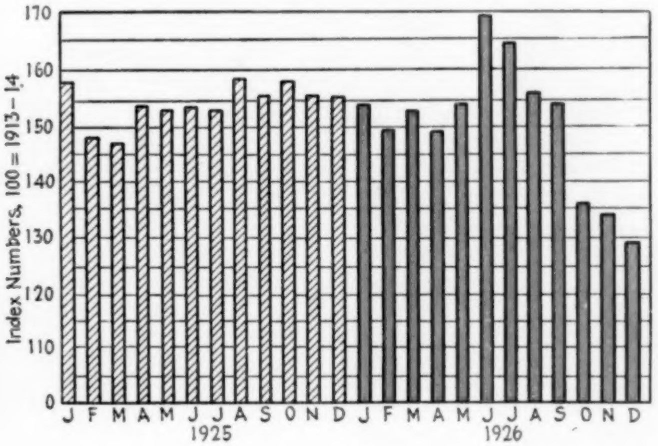
1926 SETS NEW RECORDS

CHEM. & MET. *Weighted Indexes of* PRICES

Chemicals, 1925-1926

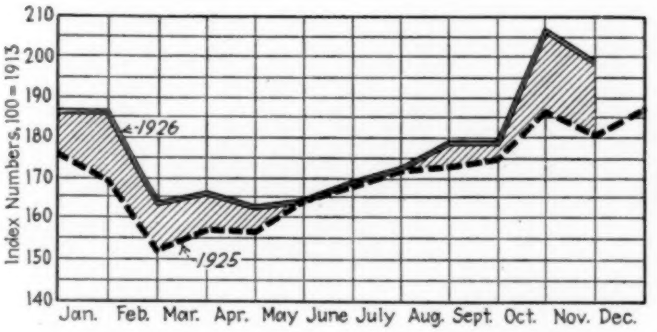


Oils and Fats, 1925-1926

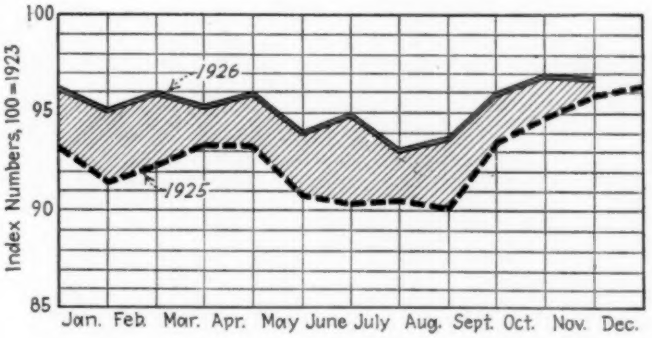


PRODUCTION *and* EMPLOYMENT *in the Chemical Industries*

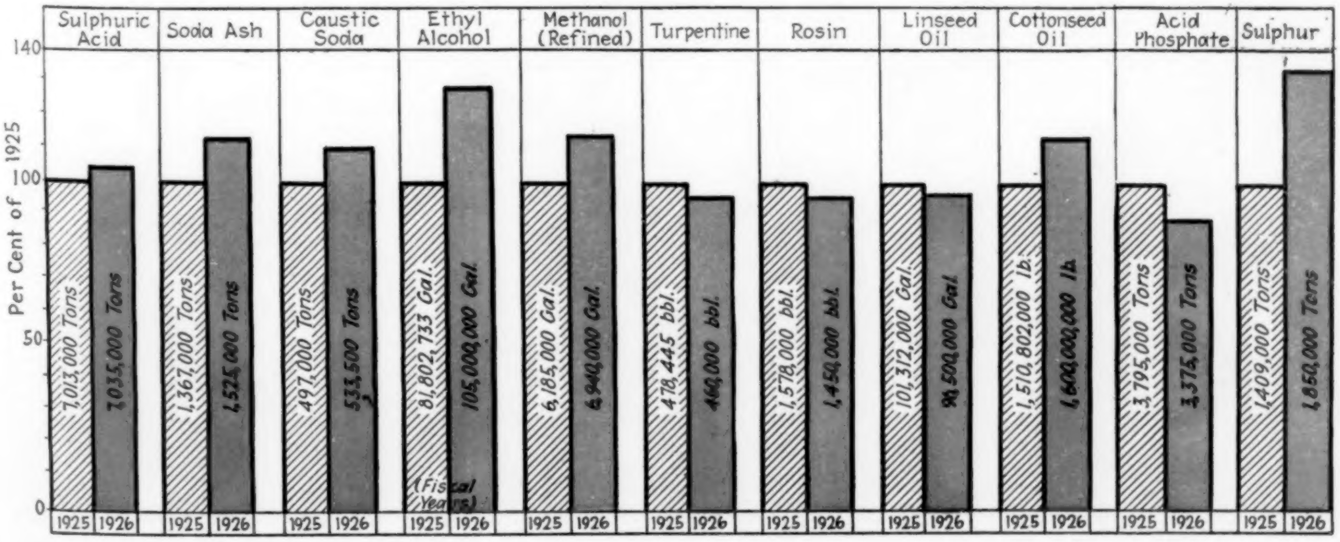
Dept. of Commerce Production Index



Dept. of Labor Employment Index



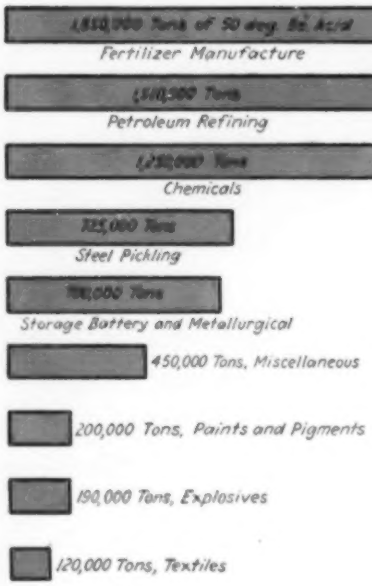
CHEM. & MET. *Estimates of* PRODUCTION *of* BASIC CHEMICALS



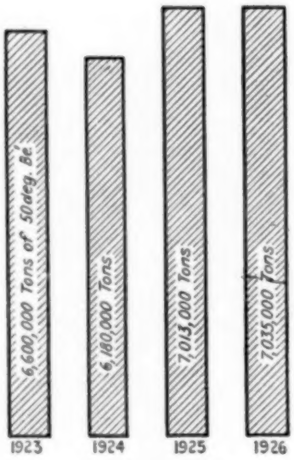
Distribution of HEAVY CHEMICALS *to*

Chem. & Met.'s annual estimates of the production and consumption by industries of the principal heavy chemicals. Following an established practice the data for years prior to 1926 have been revised in accordance with most recent census figures.

SULPHURIC ACID *in 1926*



Distribution in 1926.

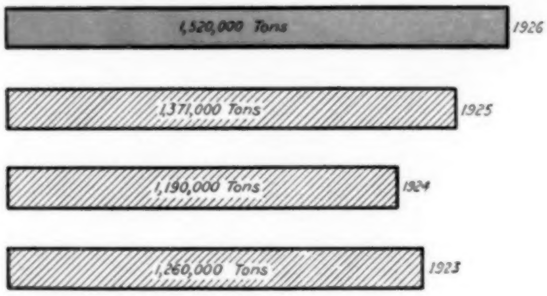


Production, 1923-6.

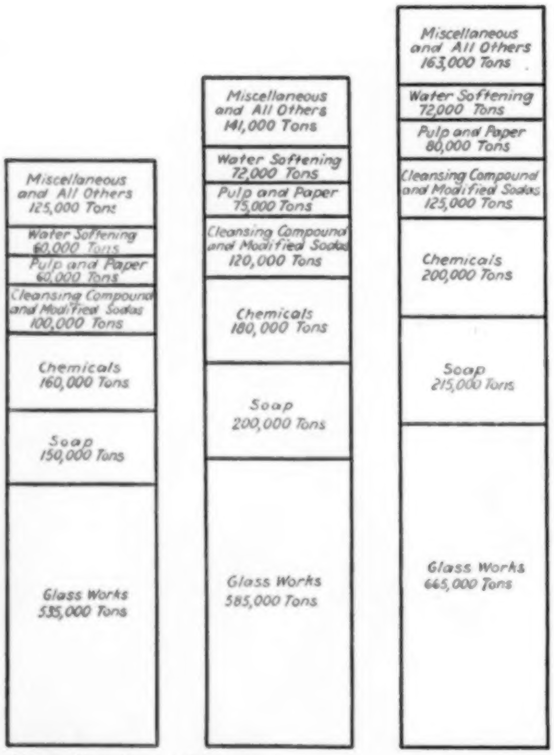
Distribution of Sulphuric Acid by Industries
(Tons of 50 Deg. Bé.)

Consuming Industries	1924	1925	1926
Fertilizer	1,800,000	2,095,000	1 850,000
Petroleum refining	1,300,000	1,450,000	1,510,000
Chemicals	1,000,000	1,100,000	1,250,000
Steel	600,000	725,000	740,000
Storage batteries and metallurgical	600,000	700,000	725,000
Paints and pigments	200,000	200,000	200,000
Explosives	180,000	185,000	190,000
Textiles	100,000	118,000	120,000
Miscellaneous	400,000	440,000	450,000
Total	6,180,000	7,013,000	7,035,000

Consumers of SODA ASH



Production, 1923-6.



Distribution, 1924-6.

Distribution of Soda Ash Sold to Consuming Industries
(Quantities in Tons)

Consuming Industries	1924	1925	1926
Glassworks	535,000	585,000	665,000
Soap	150,000	200,000	215,000
Chemical	160,000	180,000	200,000
Cleansing compounds and modified sodas	100,000	120,000	125,000
Pulp and paper	60,000	75,000	80,000
Water softening	60,000	70,000	72,000
Miscellaneous	46,000	50,000	65,000
Petroleum refining	35,000	40,000	42,500
Textiles	30,000	35,000	36,000
Exports	14,000	16,000	19,500
	1,190,000	1,371,000	1,520,000

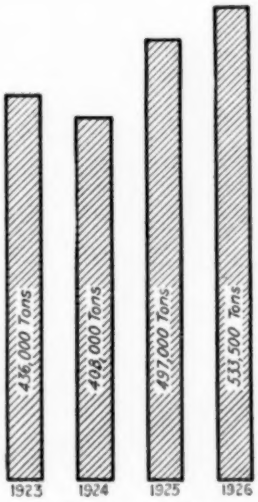
...S to the Consuming Industries

These studies are based on confidential information furnished by the producers and consumers of chemicals. They are the copyrighted property of *Chem. & Met.* but permission for their republication with proper credit will be willingly given.

Where CAUSTIC SODA *Was Used*

Distribution of Caustic Soda by Industries
(Quantities in Tons)

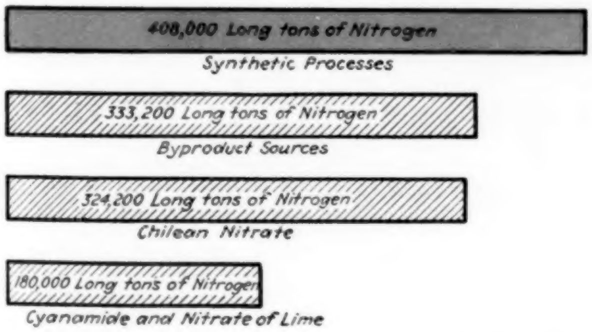
Consuming Industries	1924	1925	1926
Soap	100,000	112,000	120,000
Chemicals	60,000	75,000	85,000
Petroleum refining	50,000	57,000	60,000
Rayon	35,000	49,500	60,000
Lye	53,000	57,000	57,000
Exports	46,000	50,000	50,000
Textiles	34,000	36,000	38,000
Rubber reclaiming	7,000	17,000	20,000
Miscellaneous	4,000	15,000	15,000
Vegetable oils	11,000	14,500	13,500
Pulp and paper	5,000	9,000	10,000
Storage batteries	3,000	5,000	5,000
Total	408,000	497,000	533,000



Production, 1923-6.

Distribution in 1926.

Industry's NITROGEN *Balance*



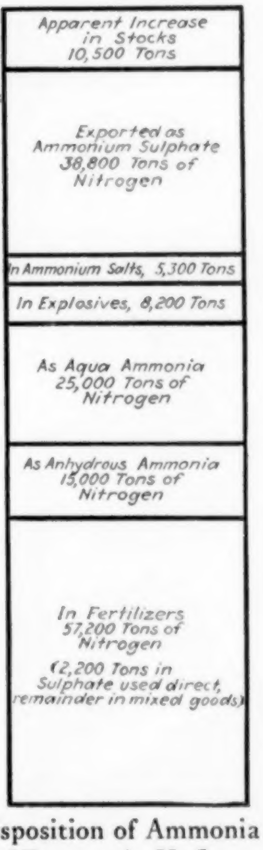
World Production of Nitrogen in Long Tons of Pure Nitrogen for year ended May 31, 1926. (Data from British Sulphate of Ammonia Federation, Ltd.)

U. S. Production and Disposition of Ammonia Products
(Quantities in Net Tons of Nitrogen)

	1924	1925	1926
Production			
At coke ovens	109,000	128,000	140,000
At gas works	5,500	5,500	5,000
From the air	3,500	11,000	12,800
Bone distillation, etc.	200	200	200
Imports as $(NH_4)_2SO_4$*	1,200	5,300	2,000
Total available	119,400	150,000	160,000
Disposition			
In mixed fertilisers	46,000	52,000	55,000
Sulphate used as fertiliser	2,000	2,000	2,200
Anhydrous ammonia	13,500	15,000	15,000
Aqua ammonia	22,000	24,000	25,000
In explosives	7,200	7,500	8,200
In ammonium salts (chemicals)	5,000	5,000	5,300
Exported as $(NH_4)_2SO_4$	26,500	27,600	38,800
Apparent increase or decrease in stocks	—2,800	+16,900	+10,500
Total disposition	119,400	150,000	160,000

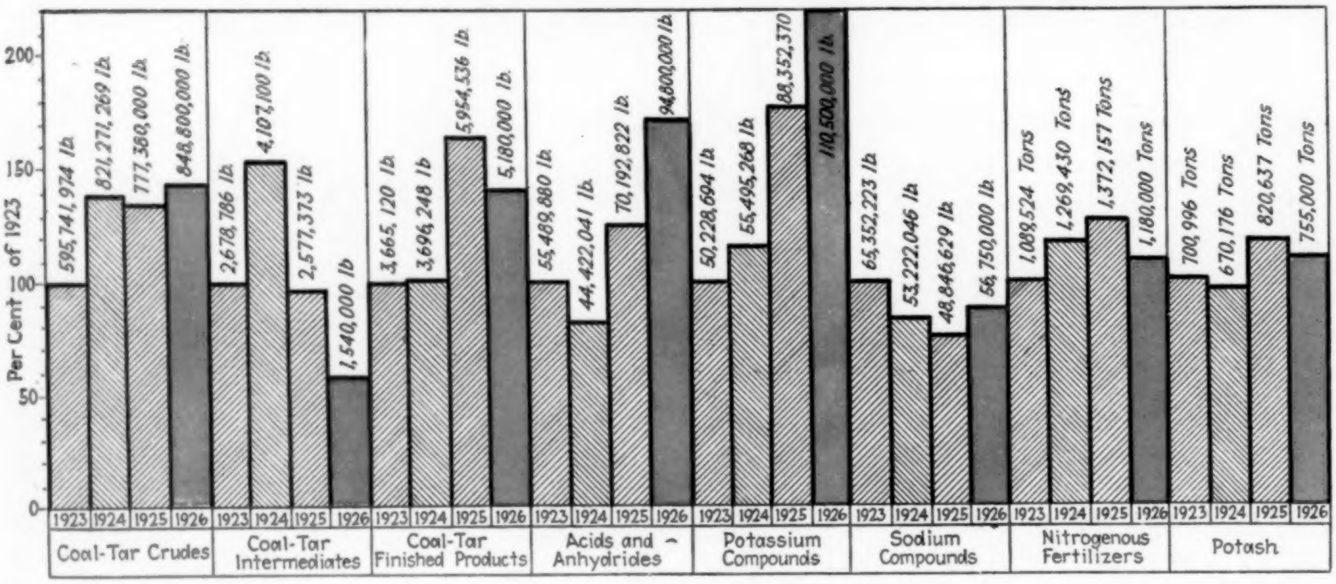
*Does not include chemical imports in various ammonium salts which in 1925 was equivalent to an additional 3,300 tons of nitrogen.

Production of Ammonia Nitrogen in U. S.



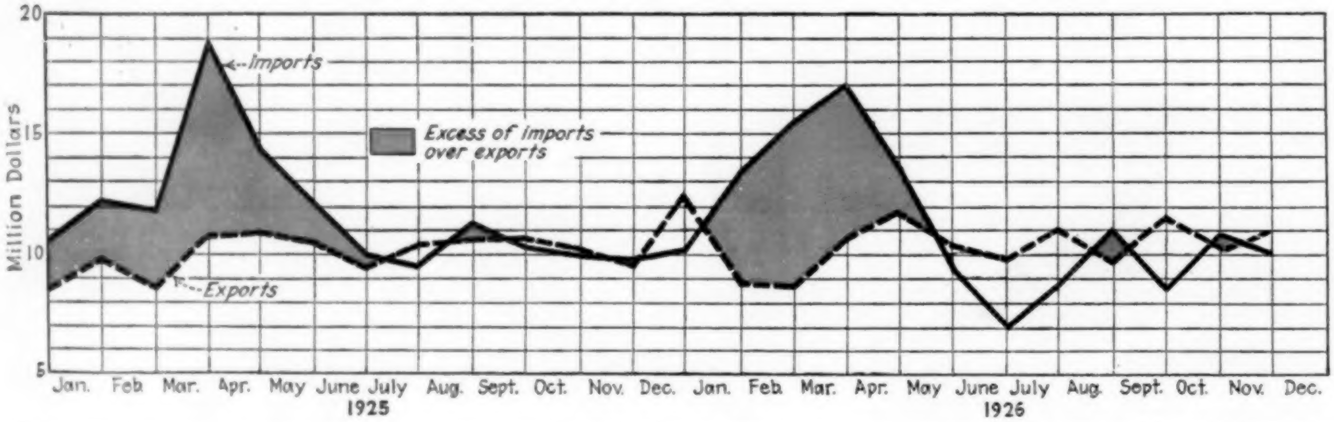
Disposition of Ammonia Nitrogen in U. S.

IMPORTS *of Chemicals by Groups*, 1923-1926

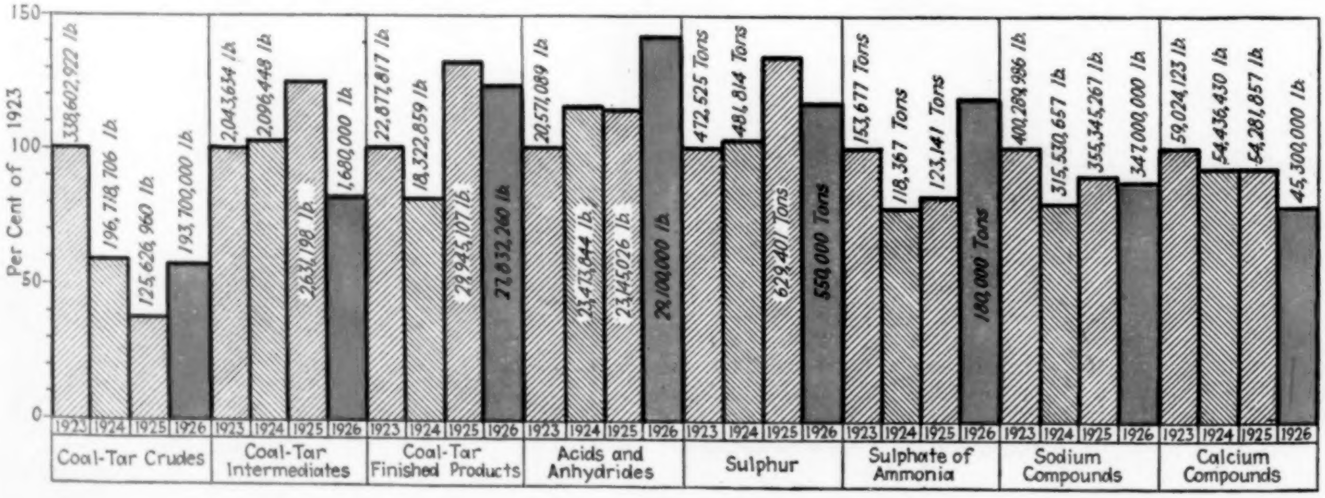


OUR CHEMICAL TRADE BALANCE

IMPORTS *and* EXPORTS *of Chemical and Allied Products*, 1925-1926



EXPORTS *of* CHEMICALS *by Groups*, 1923-1926



State of MICHIGAN *Favored with Rich Markets and Abundant Raw Materials*

By Alfred H. White

Professor of Chemical Engineering, University of Michigan, Ann Arbor, Mich.

THE motto on the seal of the State of Michigan is a quotation from Vergil's Aeneid where Queen Dido in greeting Aeneas says: "If you seek a pleasant peninsula, look about you." The lower peninsula of Michigan is frequently compared in shape to a mitten bounded on the west by Lake Michigan and on the east by Lake Huron, with these two lakes meeting at Mackinac Island. The upper peninsula is washed by the three Great Lakes, Superior, Michigan and Huron. Michigan thus occupies a strategic commercial position. The resemblance to a mitten is not only applicable geographically but also geologically, because the geological strata are depressed in the center of the state, as is the palm of the hand. The geological formations are sometimes compared to a pile of saucers. Nature gave Michigan as five great assets for a future chemical industry, iron ore, copper, timber, salt and an abundance of pure water.

The beginnings of the chemical industry of Michigan came through the waste wood from the logging operations and sawmills. This was utilized for the manufacture of charcoal in one section of the state and for the evaporation of salt brines in another section. The charcoal became one of the raw materials in the manufacture of pig iron. The timber which supplied the incentive for these first industries has almost vanished, but the industries remain.

Industrial Consumers of Chemicals

There are few manufacturers that do not use some chemical products in their business and Michigan's position as the seventh in the list of states arranged according to the value of their manufactured products indicates the potential market for chemicals. Motor vehicles and parts were responsible for more than half of the value of products manufactured in 1923. The automobile is not a chemical product, but most of its constituent parts are closely connected with the chemical industry. Disregarding the metals, as being outside of the scope of the present survey, there remain rubber, glass, textiles, artificial leather and protective coatings as chemical products in evident use in every automobile. The chemical industry is also interested in the storage battery, in plastics and other materials used in the ignition system, in the process of electroplating, in the spark plugs and in many other parts of the automobile where chemical products are used in quantities which in the aggregate are large. The oils used in cutting and heat treatment and the compounds used in case-hardening give other instances of chemical industries supplying materials needed in the manufacture of automobiles.

A list of the more important industries which involve chemical processes and are non-metallurgical, with data from the census of 1923, is given in the table herewith.

Salt and Its Products

There are extensive deposits of salt in three separate districts of the state, the southeast area around Detroit, the northeast area near Bay City and the northwest area near Manistee. All of these are adjacent to water transportation and all have become important centers of the industry, so that Michigan stands first among the states in the salt evaporated and in salt converted into alkali. In the neighborhood of Detroit the main bed of salt is at a depth of 1,200 to 1,600 ft., varies from 100 to 400 ft. in thickness and is of very high purity.

List of the More Important Chemical Industries of Michigan

From the Census of 1923

Products	Number of Establishments	Total Value of Products
Chemicals not elsewhere classified	21	$43,379,853
Clay products	34	4,243,220
Druggists preparations	14	18,144,082
Dyeing and finishing textiles	3	2,307,842
Food preparations	21	40,137,687
Gas, manufactured	59	18,692,451
Knit goods	29	12,506,896
Leather	18	21,764,691
Oil, essential	6	534,178
Paints and varnishes	24	24,817,521
Paper and wood pulp	42	85,241,815
Perfumery, etc.	16	2,440,516
Pottery	6	2,744,158
Rubber goods, not elsewhere classified	6	1,291,074
Rubber tires and inner tubes	5	27,643,518
Salt	15	11,335,618
Sugar, beet	16	17,656,557
Wall plaster, etc.	14	7,665,542
Wood distillation	14	8,830,460
Woolen goods	10	5,959,445

This same bed dips under the center of the state at too great a depth to be workable and reappears in the Manistee district at a depth of 1,900 to 2,200 ft. Since this is rock salt an artificial brine is produced by pumping down water. The brine is practically saturated, and high-grade salt may be made without treatment other than settling and evaporation. Most of the salt is made in multiple-effect vacuum pans, although salt with a peculiar crystal is made by one plant using a flash evaporation of superheated brine.

The combination of salt, cheap fuel and transportation has brought large alkali plants to the Detroit district. The Solvay Process Co. and the Michigan Alkali Co. make soda by the ammonia-soda process and convert part of it into caustic. The Pennsylvania Salt Manufacturing Co. makes chlorine and caustic by electrolytic processes at two plants within a few miles of each other.

Byproducts of the ammonia-soda industry are calcium chloride and precipitated calcium sulphate used as a filler in the manufacture of paper. Washing compounds are modifications of the main product rather than byproducts. Chlorates are a principal product at one electrolytic plant. Hydrochloric acid is a product from the electrolytic plants. The manufacture of sulphuric acid does not belong under this heading, but it may be mentioned here that sulphuric acid is made by the chamber process in two plants.

The Dow Chemical Co.

The Dow Chemical Co. operates a unique industry built upon the impure brines of the Saginaw Valley. These brines seeping through the impure upper salt beds flow to the lowest part of the Marshall sandstone which is approximately beneath the town of Midland. Mr. Herbert H. Dow, having noted the unusual amount of bromine in these brines, commenced in 1890, and with almost no capital, to extract bromine by an electrolytic process of his own invention. The manufacture of caustic soda and chlorine from the same brines followed and later the impure mother liquors were treated to recover the calcium and magnesium chlorides in pure form so that practically all of the constituents of the brine were used.

It was possibly the distance from market, handicapping the sale of the cheaper heavy chemicals which led Mr. Dow to adopt the policy of converting his materials into final products. At the present time the company is producing and selling more than 100 chemicals. It is interesting to note that in spite of the large quantity of salt which is electrolyzed, their list of products offered for sale does not include either chlorine or bleaching powder. Their catalog lists 28 pharmaceutical chemicals, 22 in the industrial group, 9 as heavy chemicals, 11 as dyes and 9 as insecticides, with the rest in the miscellaneous group. The dyes are all fast vat colors—indigo, or its derivatives, the bromindigos being a specialty of the plant. Chloroform has been produced for years and more recently salicylic acid and its derivatives, and coumarin have been added to the list. An unusual product is metallic magnesium, the cost of which is being reduced so that it is predicted that its price will soon be on a parity with that of aluminum, volume for volume. The alloys of magnesium have especial value in the construction of airplanes.

Limestone of high purity outcrops in the same general localities where salt is found. It is quarried below Detroit and at various points in the upper part of the lower peninsula. Some of the quarries are directly on the lake front. There are numerous deposits of marl in the interior parts of the state. In 1923 there were 8 establishments burning lime and 15 plants making portland cement. Some of these cement mills use local supplies of marl and clay, and others are using clay or blast-furnace slag, and limestone. Sand-lime brick is made in two sections of the state. Gypsum is mined and calcined extensively in the west central part of the state, with Grand Rapids as the center of the industry. Michigan ranks as the second state in the Union in the production of calcined gypsum. There are numerous plants making building brick from local clays. Porcelain sanitary-ware and spark plugs are produced in a few well-equipped plants. The pioneer plant for making plate glass by a continuous process is at the River Rouge plant of the Ford Motor Co.

Products from Wood

Although the virgin forests of Michigan have largely disappeared, both hard and soft woods are still being cut. The waste which characterized the early operations has been replaced by a careful study to utilize all possible values. The destructive distillation of hard woods is an industry of many years standing which has progressed from the old beehive kiln to the steel retort ovens, and in one instance, to the Stafford kiln. The primary products, charcoal, acetate of lime and crude alcohol, are being further elaborated in some of the plants to produce charcoal briquets, refined alcohol and acetone, formaldehyde and minor products. The industry has been passing through a trying period. The largest consumer of charcoal has been the blast furnace making charcoal pig iron, a product which has sold at a substantial premium over coke iron. This premium has decreased so that the price of charcoal has also had to be lowered. The acetate of lime is used mainly in the manufacture of acetone which has had to meet the competition of acetone produced by fermentation. The price of methanol has dropped because of competition with synthetic methanol imported from Germany. It has been a serious question whether this industry could survive, but it is believed that with the increased tariff protection recently allowed and greater care in all operations that the present difficulties may be overcome.

Wood is converted into paper pulp at a number of different mills operating mainly by the sulphite process. Kraft pulp is manufactured at one mill. Some of the pulp mills make their product directly into finished paper and other mills buy wood pulp and other fibers and convert them into paper. Book paper and wrapping paper form the most important items; but tissue, waxed paper, coated paper and other high-grade specialties are also produced.

The bark from the hemlock trees of the upper peninsula is leached and the extract is concentrated to form tanning extract.

Products Based on Agriculture

Beet sugar has been manufactured since 1899 and is produced in 16 plants in various parts of the state. Cattle food is a byproduct from the dried pulp. Battle Creek holds pre-eminence in the manufacture of breakfast foods. Butter, cheese and condensed milk are produced, as a further contribution to the breakfast table,

Michigan grows and roasts large amounts of chicory. One plant produces nearly half of the lactose made in the United States, and grape juice, with cream of tartar as a byproduct, is an important industry. Canned foods, pickles and vinegar are also produced in quantity. One factory makes special grades of starch for adhesives and textile work, and there is one large producer of gelatine. Thirty-six firms were engaged in the business of slaughtering and meat packing with recovery of the usual byproducts, in 1923.

Other Organic Chemical Industries

The manufacture of paint, varnish and lacquers has been established for many years. Originally catering to the domestic and furniture trade, it has been much stimulated by the growth of the automobile industry. Automobile tires and other rubber goods are manufactured in quantity. There are mills for making fabrics from silk, wool and cotton and for coating artificial leather. Eighteen establishments were tanning leather in 1923. Pharmaceutical preparations, perfumery and toilet preparations are manufactured on a large scale in Detroit. One plant produces superior grades of enzymes and gland extracts. The varied products of the Dow Chemical Co. have already been mentioned. Dyes and printing inks are produced in several smaller plants.

The Future of Michigan's Chemical Industries

Michigan's chemical industries depend in part upon a favorable combination of raw materials, cost of production and access to markets. One successful industry has brought others in its train. The demand for ammonia by the Solvay Process Co. led to the introduction of coke ovens. The surplus coke, together with the favorable location on the Detroit River brought blast furnaces and then steel plants.

The manufacture of salt and products derived from it seems certain to be in a favorable situation for many years. So also cement, lime and gypsum products seem sure of a prosperous future. The wood distillation industry has been passing through a crisis, and its future cannot be predicted with confidence. The manufacture of the wood pulp is holding its own through importation of pulp wood, and it will not be many years before the reforestation will have progressed to such an extent that a permanent supply of pulp wood grown in Michigan will be available. The soil and climate of Michigan are well adapted to the sugar beet, and the sugar industry is firmly established.

There is one important factor in industrial supremacy which is not due to natural resources nor to location. That is the caliber of the settlers. The pioneers of Michigan were from New England and New York and represented the strong and adventurous strains existing in those states one hundred years ago. Their descendants are still dominant in the industries of the state. Battle Creek is the center of the breakfast food industry because of the successful business founded by one energetic man. The Detroit district makes 75 per cent of all of the automobiles in the world because of the ability and vision of the engineers and financiers of that district. Detroit does not claim to have cheap labor. On the contrary, it boasts that its labor is the highest paid, and also the most efficient, in the world.

Michigan is in a strategic position near the center of population of the United States with excellent railway and highway systems and unrivalled water transportation. If an adequate canal from the lakes to the ocean, either through the St. Lawrence River, New York State, or the Mississippi Basin, is ever built it will be a material asset to the manufacturers of Michigan. The factors which have brought the coke ovens, blast furnaces, steel mills, automobile plants and alkali works to Michigan seem destined to give her greater industrial prosperity in the future. And in the present world, industrial prosperity requires a highly-developed chemical industry to furnish raw materials and intermediate products, and to utilize wastes and byproducts.

Slight Gain in Fertilizer Production

Production of all classes of fertilizer in 1926 was probably about 8,200,000 tons, valued at nearly $200,000,000. These figures represent a very small increase, probably about 1.25 per cent, above the production of fertilizers in 1925 during which year the output and the value in aggregate were 6 per cent greater than in the preceding census year, 1923.

The consumption of nitrogen, potash, and phosphate to make this tonnage in 1926 was, however, probably distinctly greater than the consumption of corresponding materials in the preceding year since the concentration of plant food constituents in all fertilizers has been increasing steadily since the War. The practically constant tonnage output has, therefore, represented a constantly increasing plant food supply to agriculture. Some estimate that there has been almost a 50 per cent increase in total plant food consumption in the period from 1918 to 1926. In any event, the changes of concentration of plant food constituents in such states as New Jersey, Indiana, Ohio, and some of the important southern states indicate this.

During 1926 there were sold approximately 3,600,000 tons of acid phosphate, a trifle more than in the preceding year. The stocks at the end of the year appear to have been about the same as 12 months before. The stocks on hand at the end of the spring fertilizer season had been high, both of phosphate, potash, nitrogen, and mixed goods, but curtailment in production and purchases during the last half of the year has apparently restored all stocks to nearly a normal figure at the beginning of 1927.

The prices of mixed fertilizers have not receded in proportion as raw materials costs have decreased, because apparently the industry has chosen rather to give a higher concentration of these constituents in the fertilizer as unit costs of the raw material became lower rather than to cut the sales price by the small percentage that would have corresponded to reduction in raw material cost.

Acid Phosphate Production in the United States

(Data from Bureau of the Census, except for last half of 1926)

(Unit is 1,000 tons of 2,000 lbs.)

	Initial Stock on Hand	Produced	Sold	Fina Stock on Hand
1922—1st half..	2,129	1,199	2,085	....
2nd half..	....	1,589	978	1,690
1923—1st half..	1,630	1,758	2,230	1,111
2nd half..	1,068	1,609	806	1,772
1924—1st half..	1,986	1,584	2,571	966
2nd half..	977	1,666	809	1,683
1925—1st half..	1,797	1,800	2,556	959
2nd half..	1,038	2,046	994	1,917
1926—1st half..	1,964	1,993	2,566	1,349
2nd half..	1,349	1,923	1,040	1,900

Are the Lignite Coals of the DAKOTAS *a Neglected Chemical Raw Material?*

By L. L. Carrick and W. T. Pearce

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THE industries in the Dakotas may be classed in three groups: first, those whose primary purpose is the development of natural resources, as gold and silver mining, the mining of lignite, the utilization of natural clays and stone, the extraction of wood stains from lignite coal, the cutting of timber and the development of the natural gas supply; second, those which are an outgrowth of agricultural pursuits, as manufacture of sugar from beets, flour from wheat, meat packing, candy and tobacco products; and third, those which are purely chemical, as manufacture of baking powder.

Statistics available for the consumption and sources of the more important chemicals are as follows:

5 tons caustic soda, from Ohio.
5 tons sulphuric acid, from Indiana.
30 tons hydrochloric acid, from Indiana.
5 tons soda ash, from Ohio.
25 tons sulphur, from Texas.
20 tons kieselguhr, from California.
550 cylinders of chlorine.
500,000 lb. chemicals for baking powder industry.

Established Industries

North Dakota is not an important producer of any great variety of minerals, but South Dakota is well supplied. They are located for the most part in the Black Hills District. The more important products for 1925 in the order of their value are gold, stone (including sandstone, granite and limestone), sand, gravel and gypsum. There are workable deposits of mica, lead, tungsten, tantalum, beryllium, arsenic and tin.

Practically all lithia minerals used in the United States at the present time are produced in the Keystone district of the Black Hills. In the order of importance, they are spodumene, amblygonite and lepidolite.

In 1925 the Homestake Mines in South Dakota produced gold valued at $5,950,000 and 100,000 oz. of silver.

Lignite coal is the chief natural resource of North Dakota. The entire western part of North Dakota, an area of 32,000 sq.mi., and a small strip of northern South Dakota are underlain with lignite coal. It is estimated that 28,000 sq.mi. of workable lignite beds, ranging from 4 to 35 ft. in thickness, are available. If we consider only the coal beds within 400 ft. of the surface, North Dakota has approximately 516 billion short tons. The coal is for the most part a brown lignite, although in some beds it is black and lustrous.

There are 185 lignite mines operating in North Dakota. The production for 1925 was 1,023,218 short tons, of which 915,781 short tons was consumed within the state and 112,500 was exported. The figures for lignite production in South Dakota for 1925 are not available, but the output is approximately 20,000 short tons.

Both states have large deposits of high-grade clays. They are suitable for the manufacture of pottery, brick and various other ceramic products, but at present are little utilized.

Bentonite, a clay-like material, is abundant in the foothills of the Black Hills. It is found commonly in creamy-white or yellowish bands, ranging from a few inches to several feet in thickness. Bentonite is also present in western North Dakota and is said to be of good quality.

In 1923, clay products produced were valued at $181,933. One brick plant at Hebron, North Dakota, in 1925 used 13,500 short tons of clay. The brick made from the North Dakota clay cannot compete with common brick, as the firing temperature is much higher. As a consequence the clay is utilized only in the manufacture of a high-grade face brick. As a rule it has been found impracticable to operate brick plants during the four or five coldest months of the year.

Wood stains (Dakalite) are made from the ulmic and humic derivatives of lignite. This factory has been established only 18 months and is producing 2,000 lb. of stain per shift. The plant is located in the region of lignite deposits which supply both the raw materials and fuel. It is not well located as to market.

The North Dakota timber supply is limited. It is confined to narrow belts along the streams and to the Turtle Mountain district. The supply and quality justify its use only for fire wood and posts.

South Dakota's timber supply is confined almost entirely to the Black Hills area. The timber is composed almost entirely of western yellow pine (pinus ponderosa) and a smaller amount of spruce, similar to the Engelmann spruce. There are also small stands of aspen, birch and ironwood, of no present commercial value.

During 1925, 41,128,000 ft.b.m. was cut, and of this 31,000,000 ft.b.m. was produced on the National Reserves. At the present time production has not reached a stage where it equals the annual growth. There is still considerable room for expansion before consumption equals production. Most of the lumber produced is used locally; only a small percentage is exported.

Petroleum is reported from this district, but there is no commercial production. South Dakota in 1921 produced 9,700,000,000 cu.ft. of natural gas as compared to North Dakota's 1,000,000,000 cu.ft. The gas is not utilized for industrial purposes.

This district is primarily devoted to agriculture, approximately 85 per cent of the population is rural, residing on the 162,327 farms which comprise about 75 per cent of the district area. The principal products are grains and live stock.

A sugar beet factory is located just across the boundary of North Dakota at East Grand Forks, Minn. All sugar beets at present are shipped to eastern Montana or western Minnesota. It has been in operation a part of one season. It will produce 300,000 bags of sugar each season. The sugar beets raised in this district yield from 14 to 15 per cent sugar. The industry is growing rapidly in both Dakotas.

A $1,500,000 sugar refinery is reported under construction at Bellefourche, South Dakota. It will be ready for next season's crop. The district has some 68 flour mills and grist mills which produced in 1925 cereals valued at $42,590,637. These mills are ideally located as to raw materials and fuel supply. Most of the products are sold within the district and the adjoining states. One of the largest flour mills is located at Grand Forks, North Dakota. It has been established four years.

The packing plants are admirably located in this district. Long live stock hauls and shrinkage are cut almost to a minimum.

The packing plant located at West Fargo, North Dakota, has been in operation only one year. It is now killing 1,100 hogs and several hundred cattle and sheep each week. Its expansion is already contemplated. Location as to raw materials and transportation facilities are excellent.

There are numerous small industries for the manufacture of candy, tobacco products, optical goods, ice cream, bread, butter beverages, printing and publishing and leather goods.

Plants that produce purely chemical products are not numerous in this district. There is one baking powder factory which uses over 500,000 lb. of chemicals annually. It is well located as to market but not close to raw materials.

Sound Basis for Industrial Development Exists

Transportation facilities are good. Easy access is afforded to almost any section of either state. North Dakota has 6,379 mi. of steam railways, of which 1,807 mi. is first track, as contrasted to 4,283 and 1,925 mi., respectively, for South Dakota. No new construction is being carried on at present. The combined electric railway system of both states total 53 mi., which is divided almost equally.

Although this district contains some possibilities for hydro-electric power development, its greatest bid to industry lies in the enormous amount of cheap power stored in the vast deposits of lignite coal. This coal should be utilized at the mines or be employed to produce electric power.

All industries report an abundance of help and no labor difficulties. The only possibility of a labor shortage is in the early spring or late fall when agriculture demands a large man power, but in the remainder of the year labor is abundant. There is an opening for any manufacturing enterprise which could alternate labor with agriculture.

The district would be a good location for woolen spinning or knitting mills. Power and raw materials are at hand, and the entire Northwest is a wide open market. Why transport the wool to the East and then return the manufactured articles?

The tremendous quantities of straw which are each year burned after threshing, should appeal to a manufacturer of straw board, especially when power is so cheap and plentiful.

North Dakota alone averaged 6,896,000 bu. of flax for the period 1920-1924.

Production of Nitrogen Compounds in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, the nitrogen and fixed nitrogen compounds to the aggregate value of $31,409,682 were produced for sale by establishments engaged primarily in the manufacture of chemicals. This total represents increases of 3.2 per cent and 49.1 per cent, respectively, as compared with $30,435,909 for 1923 and $21,059,976 for 1921.

The statistics for 1925 and 1923 are summarized in the following statement. The figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Production of Nitrogen Compounds by Kind, Quantity and Value: 1925, 1923 and 1921

	Year	No. of Establishments	Unit of Measure	Quantity	Value
Tota value *a*	1925	..	....	....	$31,409,682
	1923	..	....	....	30,435,909
	1921	..	....	....	21,059,976
Ammonium group:				Pounds	
Ammonia, aqua	1925	18	Pound	66,227,955	3,027,474
	1923	16	Pound	38,694,140	2,453,831
Ammonia, anhydrous	1925	16	Pound	31,724,858	6,771,876
	1923	12	Pound	23,529,382	6,414,667
Ammonium sulphate	1925	10	Pound	5,708,984	153,134
	1923	7	Pound	1,424,498	70,455
Nitrate	1925	4	Pound	136,436	20,381
Other ammonium compounds *b*	1925	..	....	....	4,776 230
	1923	..	....	....	3,607,585
Cyanides *c*	1925	..	....	....	6,688,913
	1923	..	....	....	8,724,913
Nitric acid	1925	..	Ton	26,852	3,559,695
	1923	..	Ton	21,759	2,741,370
Nitrous oxide	1925	..	Gal.	54,882,000	729,534
	1923	..	Gal.	45,296,829	730,644
Other nitrogen compounds, including nitrogen gas	1925	..	....	....	5,682,445
	1923	..	....	....	5,692,444

a Not including alkaloids; coal-tar crudes, intermediates and dyes; pyroxylin; rubber substitutes; and explosives; nor ammonia products of the gas and coke industries.

b Named in order of value for 1925: Chloride and phosphate, $4,316,359; carbonate, fluoride, molybdate and iodide, $290,626; and sulphide, oxalate and salts not specified, $169,245.

c Including Prussian blue, hydrocyanic acid, sodium and other metal cyanides and thiocyanates.

Abundant Resources of CALIFORNIA *Foster Active Growth of Chemical Industry*

By Paul D. V. Manning

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CALIFORNIA has been so often the subject of eulogies and extravagant statements as to its climate and scenery that references to its economic position in the chemical industry and a surmise as to its future part in this industry, which references include a consideration of the climatic factor, are apt to be received with a feeling akin to humor. However, in order to properly understand the position of this section of the country so far as concerns the chemical and allied industries, the influence of the climate, topography, mineral resources, agriculture and such factors must be considered.

The area of the state is approximately 158,297 square miles, it being the second largest in the United States. The northern and southern boundaries correspond on the Atlantic Coast, to a point considerably north of Providence, R. I., and to a point near Savannah, Ga., respectively. The average width is over 200 miles and the length of the coast line is more than 900 miles. Two mountain ranges in the northern part converge to one in the south. The climatic conditions induced by the position of the state with reference to the Pacific Ocean and also by the topography, are responsible for the large fertile valleys as well as the desert regions which have played and are destined to play increasingly important parts in the development of the chemical industries. The limits of elevation are wide, a part of the area being under sea-level. In one county is the highest point in the United States, Mt. Whitney, as well as the lowest, Death Valley.

Such growth as has taken place up to the present time may be considered with a few exceptions, to be rather localized and mainly of interest to Pacific Coast markets. The problem of transportation is one which has been a great retarder of the advance of industries throughout the whole West. Although this problem often aids in the instigation of industries here, because it is also a problem when shipping in goods from other sources, it nevertheless throttles industries once established by limiting their markets. It has been felt by all Western industries and is still ever-present as far as the use and development of natural resources are concerned. Consequently, most of the industries have begun on a small scale, manufacturing only enough to supply local markets and this has resulted in the establishment of a number of small plants in different vicinities manufacturing the same commodities.

To get a foothold in the local markets it was necessary to make a cheaper or a better product than was shipped in. It was often better or at least better suited for local conditions and for this reason the base price was higher than that of the Eastern product. The price was even then not as high as the Eastern price plus freight and it has been necessary for many Eastern manufacturers to equalize the cost to consumers of their products. This has forced many to build Western plants or lose the business.

Development was first due to the mineral resources of the state. This has not ceased in activity but has become increasingly important each year although the relative importance of the various substances has changed markedly. Most of the mountain regions, which constitute about 60 per cent of the area, are highly mineralized and the deserts have been the site of the concentration of many of the soluble constituents of those minerals. The mountains, deserts, fertile valleys and seashores have all participated in the concentration of the vegetable residues of the past ages into fuels.

The total mineral production since 1887 is shown in Table I. The table has been abridged, the figures giving the production for each fifth year between 1890 and 1920.

The production of petroleum has grown enormously, almost a quarter of that produced by the world coming from California in 1923 and 1924. At the close of 1924, there were 11,319 producing wells in the 24 fields of the state. It will be noted that the production of other mineral products increased steadily throughout the period until 1925, a slight decline taking place in this year.

A measure of the stability of the production and the development of industry may be taken as the yield of

Table I—Total Mineral Production in California

Year	Total Value All Minerals	Value Gold	Value Petroleum	Value of All Minerals But Gold and Petroleum
1887	$19,785,868	$13,588,614	$1,357,144	$4,840,110
1890	18,039,666	12,309,793	384,200	5,346,673
1895	22,844,663	15,334,317	1,000,235	6,510,111
1900	32,622,945	15,863,355	4,152,928	12,506,662
1905	43,069,227	19,197,043	9,007,820	14,864,364
1910	88,419,079	19,715,440	37,689,542	31,014,097
1915	96,663,369	22,442,296	43,503,837	30,717,236
1920	242,099,667	14,311,043	178,394,937	49,393,687
1921	268,157,472	15,704,822	203,138,225	49,314,425
1922	245,183,826	14,670,346	173,381,265	57,132,215
1923	344,024,678	13,379,013	242,731,309	87,914,356
1924	374,620,789	13,150,175	274,652,874	86,817,740
1925*	422,974,500	13,065,330	330,609,829	79,299,341
Total for period	$3,893,370,316	$641,813,072	$2,213,747,928	$1,037,809,316

*Preliminary figgures.

all other minerals excepting gold and petroleum. It will be noted that there was a rather sharp increase of this classified mineral production during the war period but that there was no corresponding decrease following the war. This means that while there were certain substances produced during the war that could not be economically produced in California after the war, there was a sufficiently greater increase in the production and prices of certain other mineral products to more than offset this difference. Moreover, in many cases there was an increase in efficiency and a lowering of costs due to research, which permitted certain other industries to continue. The production of gold has been practically constant since the war.

Numbered among the mineral products totaled in the above table are such substances as cement, soda, potash and borax. These are classified for the years 1921 to 1925, in Table II. While there are a number of substances given in this table that are not strictly of the chemical industry, most of them bear a close relationship to it or to allied industries. A few others not pertinent are added for purposes of comparison. The outstanding industries from the viewpoint of mineral production are those producing petroleum, natural gas, cement, copper, gold, silver and borax, the increase in the production of cement, copper, petroleum and natural gas being remarkable.

The cement produced in 1925 came from ten cement plants. Eleven were operating in 1926 and there will be at least one new plant in operation in 1927. All of these mills are of the usual type excepting one, the plant of the Pacific Portland Cement Co. at Redwood City, which utilizes marine shells as a source of calcium carbonate. The fuels used are oil and natural gas.

The borate production, in which California leads the United States, is from two general sources. Colemanite is produced in several parts of the state and is calcined and shipped to refineries. There is also a considerable quantity of the sodium salt produced by two plants evaporating Searles Lake brine. The borax finds a ready market in the production of enameled coatings, glass, soap and boric acid. The capacity of the largest producer is now being increased and development of other natural saline resources promises a further increase in state production in the future.

In 1924, California produced about 3 per cent of the copper mined in the country. This is not a large proportion and the state is ranked as eighth in production of this metal. At the same time the demand for refined copper is high, the total requirements in new metal for 1923 being estimated as about 42,000,000 lbs. for the southern California district alone. The nearest refinery is at Tacoma, Wash., so that it is apparent that there is an opportunity for such an establishment in the state. This is emphasized by the fact that the neighboring state of Arizona ranks first among the copper producing states. The uses of the metal on the Pacific Coast do not differ essentially from uses in other sections of the country. There are certain advantages such as cheap electric power and oil which would favor the establishment of a refinery. There are five smelters, three of which were idle in 1924.

The production of gypsum, which is used chiefly as a

Table II—Production of Mineral Substances in California for the Years 1921 to 1925

Substance	1921		1922		1923		1924		1925	
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value
Asbestos, tons	410	$19,275	50	$1,800	20	$200	70	$4,750	...	...
Barytes, tons	901	4,809	3,370	18,925	2,925	16,058	...	...	...	...
Bituminous rock, tons	8,298	43,192	4,624	13,570	2,945	11,780	6,040	14,922	...	...
Borates, tons	50,136	1,096,320	39,087*	1,068,025	62,667	1,893,798	52,070	1,599,149	46,124	$1,526,938
Brick and hollow tile	...	5,570,875	...	7,994,991	...	9,738,082	...	9,137,908	a	a
Cement, bbls	7,404,221	18,072,120	8,962,135	16,524,056	10,825,405	25,999,203	11,655,131	23,225,850	13,206,630	25,043,335
Chromite, tons 45% Cr_2O_3	347	6,870	379	6,334	84	1,658	350	6,700	591	10,912
Clay (pottery), tons	225,120	362,172	277,232	473,184	376,863	697,841	417,928	651,857	a	a
Coal, tons	12,467	63,578	27,020	135,100	1,010	5,090	1,425	8,800	730	3,880
Copper, lbs	12,088,053	1,559,358	22,883,987	3,090,582	28,346,860	4,166,989	52,089,349	6,823,704	46,968,499	6,669,627
Dolomite, tons	31,195	99,155	52,409	114,911	69,519	142,615	28,843	71,271	42,852	104,900
Feldspar, tons	4,349	28,343	4,587	37,109	11,100	81,800	9,055	68,112	a	a
Fuller's earth, tons	1,185	8,295	6,606	48,756	3,650	55,125	5,290	67,295	5,280	91,842
Gems	...	10,954	...	1,312	...	13,220	...	4,800	a	a
Gold	...	15,704,822	...	14,670,346	...	13,379,013	...	13,150,175	...	13,065,330
Granite	...	725,901	...	676,643	...	760,081	...	1,211,046	a	a
Gypsum, tons	37,412	78,875	47,048	188,336	86,410	289,136	25,569	53,210	107,613	172,444
Iron ore, tons	1,970	12,030	3,588	18,868	3,102	18,665	a	a	a	a
Lead, lbs	1,149,051	51,707	6,511,280	358,120	9,934,522	695,416	4,984,387	398,751	7,352,422	639,661
Lime, tons	46,353	610,619	57,875	671,747	70,894	788,834	62,029	703,355	a	a
Limestone, tons	75,921	305,912	84,382	282,181	143,266	348,464	219,476	582,660	a	a
Lithia, tons	...	...	...	a	a	a	109	2,269	...	...
Magnesite, tons	47,837	511,102	55,637	594,665	73,963	946,643	67,236	900,183	64,232	872,944
Magnesium Salts, tons	4,153	106,140	3,036	89,788	3,662	116,031	4,823	145,883	4,221	132,553
Manganese Ore, tons	1,005	12,210	540	7,650	690	10,620	1,115	25,785	532	11,500
Marble, cu.ft	30,232	98,395	38,321	127,792	28,015	124,919	61,579	140,253	a	a
Mineral paint, tons	446	4,748	1,620	13,277	1,049	11,773	532	5,234	669	6,969
Mineral water, gals	3,446,278	367,476	4,276,346	486,424	5,487,276	616,919	8,159,211	818,726	a	a
Natural gas, M cu.ft	67,043,797	4,704,678	103,628,027	6,990,030	240,405,397	15,661,433	209,921,596	15,153,140	194,719,924	15,890,082
Petroleum, bbls	112,599,860	203,138,225	138,468,222	173,381,265	262,875,690	242,731,309	228,933,471	274,652,874	232,492,147	330,609,829
Platinum, fine oz	613	58,754	795	90,288	602	78,546	273	36,452	292	39,937
Potash, tons K_2O	14,806	390,210	17,776	584,388	29,597	709,836	33,107	747,407	36,355	829,770
Pumice and volcanic ash, tons	406	6,310	613	4,248	2,936	16,309	4,919	33,404	5,319	32,937
Pyrites, tons	110,025	473,735	151,381	570,425	148,004	555,308	124,214	517,835	129,500	528,550
Quicksilver, 75 lb. flasks	3,157	140,666	3,466	191,851	5,458	332,851	7,948	543,080	7,683	621,831
Salt, tons	197,989	832,702	223,238	819,187	275,979	1,130,670	318,800	1,159,137	284,068	949,826
Sandstone, cu.ft	10,150	2,112	900	1,100	7,000	13,000	6,700	3,600	a	a
Silica (sand and quartz) tons	10,569	49,179	9,874	31,016	7,964	30,420	6,808	35,006	a	a
Silver, fine oz	...	3,629,223	...	3,100,065	a	2,918,743	a	2,381,952	3,054,416	2,106,871
Soapstone and talc, tons	8,752	130,078	13,378	197,186	17,439	252,661	16,179	242,770	15,465	239,084
Soda, tons	14,828	438,996	20,084	573,661	34,885	764,284	32,536	711,796	48,625	947,649
Tungsten concentrates, tons	...	...	...	...	34	19,126	781	446,009	573	348,471
Zinc, lbs	846,184	42,309	3,034,430	172,963	...	...	3,060,000	198,900	11,546,602	877,542

*Recalculated to 40% anhydrous acid equivalent beginning with 1922.
Tables I and II 2 compiled from data obtained from Calif. State Mining Bureau.
a indicates data not available.

retarding agent in cement, suffered a decline in 1924, due chiefly to a lowered production from several deposits which have recently changed management. An increase in 1925 was promised but no figures are as yet available.

The magnesium salts produced in the state come from two sources. There is a small amount of the sulphate produced, mainly for medicinal and bath salt purposes. A deposit of this salt near Death Valley is owned by the American Magnesium Co., of Los Angeles. A monorail about twenty-five miles in length has been built through the desert mountains connecting these deposits with the Trona R.R., at Magnesium. This mode of transportation is still in the experimental stage and it is understood that operations will again be started, after a refinancing, in 1927. The crude salt is to be shipped to seaboard for refining. The remaining magnesium was produced in the form of the chloride, both as a solid and as a solution. Large quantities of this product are used in California in the manufacture of stucco and "sorel" cement. The chloride is produced by processing the bittern, which is the discard product in the manufacture of common salt by solar evaporation of sea water. There are two plants producing the solid and liquid. The latter is marketed as a 34 to 36 deg. Bé. solution. As the use of stucco and magnesite cement is increasing rapidly, the demand for the chloride will be greater. Competition is with the German product. The average price of the domestic product in 1925 was $32 per ton at the plant. New plants are contemplated and about 80 per cent of the available bittern will be used. Another product from this process is bromine which is produced by one plant. Bitterns in the extreme southern part of the state are about thirty times more concentrated in bromides than any known brines excepting those of the Dead Sea. New plants to be erected for processing the bitterns will also produce bromine.

Natural gas and petroleum seem to offer the greatest possibility in chemical development. Extensive research is now underway looking to the production of chemical byproducts from petroleum and natural gas. The progressive spirit exhibited by the Western producers is remarkable and it appears that a real technology of petroleum is being developed in the Western oil fields and gradually adopted in mid-continent and Eastern fields.

Potash Production Increases

The production of potash shows a healthy growth. It is chiefly produced as a chloride from Searles Lake, by evaporation of brine pumped from below the surface in the crystal bed. This "lake" is usually dry at the surface. Practically all of the potash so produced is the product of the American Potash & Chemical Corporation, formerly the American Trona Corporation. A small amount is produced by the plants processing bittern from the salt works. The production of potash will be increased during the coming year with the enlargement of the plant at Searles Lake. The product was first produced in California in 1914 when a small amount was made from kelp. This process is not now in operation but a plant is being erected for the purpose of processing kelp, and potash is one of the products which is to be recovered. With the increase in activity in the bittern treating plants, the amount of potash produced from this source should be increased. When the price of potash is high, some is recovered as the sulphate by the treatment of cement kiln dust. The California potash is sold mainly in the fertilizer market, a small amount going for the manufacture of caustic potash.

The pyrites mined in California is used in the production of sulphuric acid. A part is used directly for fertilizer and in the manufacture of insecticides. The production figures for pyrites do not include that roasted in the production of metals from ores. The manganese ore produced is used almost entirely on the coast in the production of ferro-manganese.

Until the recent opening of deposits in Washington and the establishment of plants there, California produced all the domestic supply of magnesite. A part of the state production is used for refractory purposes and some in the manufacture of paper from wood pulp, but the largest part goes into cement and stucco.

Fuller's earth includes here such substances as "Bentonite" and is used almost entirely in petroleum refining as a clarifying agent.

A large amount of diatomaceous earth is produced in the state. Seven companies in 1924 were marketing various grades of this substance. It is mainly used as a clarifier, filter aid and heat insulator. Approximately 90 per cent of the production is by one producer and the total value is in excess of $1,000,000 annually. Most of the development in this line has taken place since 1919.

The figures on limestone do not include that used for construction work, cement, etc., but do include that used in smelting, sugar manufacturing, fertilizers, glass, rubber, paints, chemical works and the manufacture of carbon dioxide.

The sand and silica produced goes into the manufacture of glass, glazes, water glass and specialties such as roofing, cleaners and paints. The decrease in production is due to the importation of Belgian sand used in the manufacture of sodium silicate.

Practically all of the salt produced in California is through evaporation of water from the Pacific Ocean. In 1925 there were nineteen plants operating on this brine and one making medicinal salts from the brine of Mono Lake. Small amounts are produced from dry lake beds in the desert regions, notably at Searles Lake and in the Saline Valley. The production from the latter source will probably be increased during the coming year.

The manufacture of soda in its various forms is an industry which gives promise of a rapid growth to stable production. A small amount of the sulphate comes from the desert region at Carrizo Plains. It is mainly used in glass and paper production. The natural soda or trona is found at Searles Lake and at Owens Lake. It is used in the manufacture of sodium silicate, caustic soda, soaps, cleaning compounds and in metallurgical work. The production of these two soda compounds entails merely loading and shipping. By far the greater amount of soda is produced in the form of light and dense ash. These are made by two plants at Owens Lake, the combined capacity being about 150 tons of ash per day. In these plants, brines from the trona beds, either natural or manufactured, are filtered and carbonated in towers. Lime is burned to furnish the required carbon dioxide. The carbonate in the brine is changed to bicarbonate, the larger part of which precipitates during the carbonation and is filtered out. Some of this bicarbonate is marketed as such but the

Table III—Number of Plants of Chemical Industries in California 1923 Census Unless Otherwise Noted

Product	Plants	Product	Plants
Acetylene	5	Nitrous oxide	3
Acetic acid	1	Oxygen	9
Arsenic Acids	1 (1925)	Crude potash	3
Boric acid	1	Potassium bitartrate	1
Carbonic acid	5	Sal soda	6
Citric acid	4 (1926)	Salt cake	3
Hydrochloric acid	4	Soda ash	4
Hydrocyanic acid (liquid)	3 (1926)	Modified sodas	3
Mixed acids	2	Bicarbonate of soda	2 (1926)
Nitric acid	5	Borax	3
Sulphuric acid	8	Caustic soda	2 (1926)
Reclaimed sulphuric acid	4	Caustic soda repacked	1
Tartaric acid	1	Sodium hypochlorite	2
Aluminum Sulphate	1	Sodium nitrate (ref.)	1
Amyl acetate	1	Sodium silicate	2
Arsenic oxides	1	Sodium sulphate	2
Arsenate of lead	2	Sodium sulphide	1
Barium sulphate (pptd)	2	Sodium sulphite	1
Calcium chloride	1	Sodium cyanogen compds	1 (1926)
Calcium hypochlorite	1	Sodium hyposulphate	1
Carbon bisulphide	1	Sulphur (ref.)	4
Chlorine	1	Zinc chloride	1
Bromine	1 (1926)	Zinc sulphate	1
Copper carbonate	1	Milk condenseries	25 (1925)
Copper sulphate	1	Casein	14 (1925)
Ethers	1	Dried milk	9 (1925)
Ethyl acetate	1	Sugar, beet	6
Ethyl alcohol	3	Sugar, cone	2
Glycerine, crude	8	Bone black	2
Glycerine, ref	1	Essential oils	2
Hydrogen	4	Matches	2
Hydrogen peroxide	1	Wood pulp goods	1
Iron sulphate	1	Wood preserving	2
Lead acetate	1	Tanning extract (oak)	1
Magnesium chloride	2 (1926)	Agar agar	1 (1926)
Magnesium oxide	1	Alginic acid	1 (1927)
Magnesium sulphate	3	Pectin	1 (1926)
Niter cake	2		

All figures except otherwise noted are from 1923 Census. Others from data collected by the writer.

greater part of it is calcined to make light soda ash. This finds a ready market in the manufacture of chemicals, soaps and other products. Subsequent treatment of the light ash gives a dense ash which forms one of the principle raw materials in the manufacture of glass.

A recent development at Owens Lake is the Clark Chemical Co. plant for the manufacture of caustic soda from trona. This plant is just coming into production and has a capacity rated at 30 tons of caustic per day. A part of the caustic will be marketed as a liquid since in this form it is in large demand by oil refineries. The Mount continuous process is used.

The state's output of zinc is usually marketed as an oxide but in 1925, practically all of it was shipped as a concentrate to Belgium for treatment. There are a number of other mineral chemicals produced in small quantities. These include antimony, arsenic, iron ore, sulphur, calcium chloride, aluminum sulphate, shale oil and potash alum. Statistics in many of the industries are not available owing to the fact that there are but one or two operators in each field. The value of the minerals and mineral products in this group for the years 1923 and 1924 is $2,482,047 and $1,968,399 respectively.

Agriculture Fosters Chemical Industry

The hypothetical value of all crops in California (numbering around 180) in the year 1925 was $477,806,000, the state ranking second in this. The value of raw farm products is from 35 to 45 per cent of the total income of the state and about 25 per cent of the manufacturing industries are engaged in processing the agricultural products. Chemical industries of importance have therefore arisen out of the treatment of agricultural crops and byproducts as well as in the manufacture of certain chemical products used in the agricultural industry.

Another development is due to the increase in demand for chemical products by other industries and by the consumers direct. It is caused by the increase of population of the section and the growth of other industries. The state population for the years 1900, 1910, 1920 and 1926 is given as 1,485,053; 2,377,549; 3,426,861 and 5,110,245 respectively, the latter figure being a conservative estimate for 1926 at the end of July. Such a growth in population requires a corresponding growth in manufacturing industries though this necessarily lags considerably. Some of these industries are chemical while many others use chemical products as raw materials. Tables III and IV give as many statistics as are available from authoritative sources for the industries of a chemical nature. Since the latest U. S. Census of Manufacturers available at this time is that of 1923, a number of these statistics are far from being correct for the present year. The large increase in population in the period 1920-1926 has started a tre-

Table IV—Classified Chemical and Related Industries of California, 1923 Census

Industry	Number of Plants	Number of Employees	Primary Hp.	Coal Used, Tons	Value of Products	Value Added by Manufacture
Artifical stone	97	1,282	2,017	.....	$4,938,938	$3,052,931
Baking powders and yeast	4	174	2,612	.....	2,454,106	1,839,847
Beverages	155	1,418	5,683	64	8,813,406	4,890,380
Blacking and dressings	8	53	30	.....	354,015	187,976
Non-ferrous alloys	51	1,060	1,581	111	5,774,975	2,363,692
Bakery products	1,117	10,283	10,040	776	60,401,871	28,334,592
Canning fruits and vegetables	296	19,971	24,243	502	158,024,350	67,635,998
Cement	9	3,854	50,274	.....	26,556,322	16,990,738
Unclassified chemicals	49	1,822	22,270	283	13,045,124	6,553,966
Clay products (no pottery) non-clay refractories	70	5,136	17,907	10,146	17,488,167	13,359,432
Cleaning compounds	17	91	91	.....	637,007	361,189
Confectionery	191	3,933	3,426	.....	18,471,759	8,183,964
Druggist preparations	8	209	87	6	906,852	664,057
Electroplating	33	340	621	.....	999,132	797,584
Explosives	3	610	3,526	85	5,997,956	2,634,519
Fertilisers	12	304	2,717	.....	3,598,565	776,627
Flavor extracts	13	85	76	.....	717,449	370,088
Flavoring syrups and bitters	12	157	138	212	2,514,466	1,346,488
Gas (manufactured)	51	2,652	27,692	.....	17,672,515	11,700,010
Glass	13	1,438	3,069	.....	5,144,677	3,101,765
Ice, manufactured	142	2,009	53,429	.....	9,844,894	7,093,917
Tanneries	20	1,396	4,765	165	11,703,803	4,977,273
Lime	8	259	630	.....	1,077,853	759,540
Distilled liquids, ethyl alcohol	3	154	599	.....	821,678	214,392
Cottonseed products	6	269	5,851	.....	4,548,993	1,213,566
Other oil not from petroleum refined	15	388	2,853	.....	10,440,533	1,635,816
Paints	52	1,690	6,310	.....	18,743,093	6,833,170
Paper and wood pulp	7	1,163	17,548	.....	9,033,543	3,281,456
Patent medicines	64	706	1,093	28	4,356,857	2,364,469
Perfumes, etc.	27	169	72	.....	876,236	535,295
Petroleum refined	48	9,280	46,383	.....	267,382,871	85,711,627
Pottery	14	871	1,541	.....	3,691,325	2,886,294
Unclassified rubber	15	1,041	4,745	45	4,567,170	2,418,826
Tires	8	1,926	11,270	1	15,444,274	7,591,348
Salt	14	441	2,120	160	2,072,683	1,180,001
Soap	21	669	2,376	27	12,947,137	5,154,035
Sugar (beet)	6	1,116	19,848	.....	14,157,150	5,544,436
Condensed and evaporated milk	20	658	3,478	.....	12,796,283	2,330,195
Varnish	5	131	111	.....	1,257,345	506,685

mendous industrial growth and much of this has taken place since 1923, especially in the chemical industry. Production figures are not available in cases where there are but one or two plants of a certain industry, these figures being hidden and unapportioned in the Census Reports for a number of states having but one or two such establishments.

The following table gives the heavy acid production for 1923. These figures are the latest available:

Acid	Plants	Production, Tons	For Sale, Tons	Vaue
HCl	5	6,536*	......	....
HNO_3	5	6,208*	......	....
Mixed	2	....	......	....
H_2SO_4	8	5,119— 50 deg. Bé.	5,119	....
	..	35— 60 deg. Bé.	......	....
	..	14,782— 66 deg. Bé.	13,159	....
	..	264,372—100 per cent	253,739	....
Total	..	452,198†	432,600	$5,196,919

*Basis 100 per cent acid. †Basis 50 deg. Bé.

A part of the sulphuric acid is a byproduct from roasting the ores of gold and copper. A part of the acid goes into the manufacture of explosives and fertilizers and a large amount of it into the treating of petroleum distillates. Several of the large oil refineries operate their own contact process plants.

Soap products are classified as follows:

Soft soaps	valued at	$26,713
Hard soaps		7,425,722
Soap powders		3,406,271

The glass prodücts consist of building, plate, pressed and brown glass as well as bottles, etc. A large plant is to be built soon near Los Angeles where most of the other plants are now located.

Fertilizers made in the state in 1923 are classified into the following varieties:

	Tons	Value
Complete	51,681	$2,738,948
Ammoniated	6,216	333,805
Superphosphates	12,525	212,840
Others	16,666	490,126
Total	87,088	$3,775,719

In 1924, the cottonseed treated amounted to 35,000 tons, the products being valued at $1,140,000. Beet sugar in the same year was obtained by 8 plants from 783,000 tons of beets valued at the farm at $7,174,000.

Liquid hydrocyanic acid is made from alkali salts, some of which are made by the modified Bucher process, some shipped in from the East and some from Canada. This gas is used in the fumigation of citrus trees. Citric acid and orange oil as well as pectin form valuable by-products of the citrus industry. Some citric acid is made as a by-product in the canning of pineapples. A part of the acid is marketed as the sodium and calcium salts.

There are undoubtedly some industries not listed in the tables but the data available is very meager on current operations, development of the whole chemical industry being so rapid as to render difficult the task of collecting and keeping up such data.

Chemical Engineers Must Apply Economic Principles of Plant Location

New trade demands and new processes will require new plant locations. Some of these will be fixed by the nature of the produce, others will seek that strategic point where all of the factors involved are best satisfied. Whatever the line of effort in the United States to-day, severe competition is felt. Much distress in this direction results from over-production and lack of market organization. If we produce or manufacture more commodities than can be sold, let us redirect our efforts toward channels less congested. However, manufacturing as a business is bound to increase and expand within our territory. Our market conditions may be much improved and broadened. We recommend a careful study of these. Many groups of trained men working upon problems of this character throughout the country will furnish information of great value to the commonwealth.

We further recommend: The maintenance of an active department of market survey to be made a part of the technical force of every large manufacturing operation. We stress the word "active" as no feature of a business may change more rapidly than its market. A survey of conditions has not been completed before many new features must be considered.

Our final suggestion relates to a broadening of our manufacturing area to cover as far as practicable the entire United States. The strife for wealth, independence, and place, with the material advantages accompanying these, has produced huge centers of industry at the expense of all others. Many of the great economic changes in the United States in the near future will hinge upon this supreme effort for position. Our best national interests are not in accord with the idea that four or five industrial sections should constantly grow and congest and that others shall decrease, but we look for the equable development of our entire territory. That this condition may be brought about, every town, village, and city must originate and cultivate a market for products that can be produced at a profit from tributary natural resources and sold at home and abroad. Communities from the Atlantic to the Pacific must awaken to the fact that severe competition for the best location may be of great benefit to the town that can manufacture and market any product at a profit and in competition with other towns because of some decided local advantage. In thousands of cases, transportation costs of our manufactured goods are now excessive and the very remoteness of the plant from its market is of great disadvantage both to the producer and to the consumer. If no effort is made, many of our smaller communities will meet the fate of thousands that have been absorbed by adjacent commercial cities dominated by forceful and progressive men. If the smaller community can be aroused and its people given remunerative employment, the whole fabric of national life will be woven closer, broadened, and strengthened.

Finally, we offer two remedies for over-production and lack of market. The first is the broadening of home markets through the awakening of idle communities and reciprocal trade with other nations, particularly those of South America. The market survey can be applied to any locality. Such an analytical method is simple and direct. It will uncover weak spots in trade conditions. Having discovered these, the business men of the town should arrange a progressive policy that will eliminate these weaknesses.

Excerpts from a paper on "Location and Markets, by Wm. M. Booth, consulting engineer of Syracuse, N. Y., presented before the symposium on plant location held by the American Institute of Chemical Engineers at Birmingham, Ala., December, 1926.

Modern Plants in ILLINOIS *and* INDIANA *Would Improve Efficiency of Chemical Industry*

By Harry McCormack

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IN THE DISTRICT discussed in this report, i.e., the states of Illinois and Indiana, exclusive of that portion of Illinois lying adjacent to St. Louis, the manufacture of many of the heavy chemicals, particularly the acids, is well represented.

The chief product of the district is chamber process sulphuric acid, which at many of the plants is concentrated to 93 per cent to meet the demands of certain customers. Most of the chamber plants were built many years ago and are now out-of-date. They function satisfactorily in producing acid and the company officials therefore, probably feel that they can not afford to replace them with more modern plants. There are three chamber plants in the district which would class as representative up-to-date plants. There is a distinct difference between the performance of these plants and the old timers.

Sulphuric acid by the contact process is made in plants using the Grillo-Schroeder, the Mannheim, and the Badische processes. These plants were all built prior to 1914 and are distinctly different types from the contact-process sulphuric-acid plants evolved and constructed in the period from 1917 to 1919.

The source of sulphur used in making the acid varies widely. Some plants secure their sulphur dioxide by roasting zinc ores, some by roasting iron pyrites coming from Illinois and Indiana coal washeries, and some plants burn sulphur coming from the Gulf coast sulphur deposits.

The roasting equipment used varies more widely even than the source of sulphur. Some of the roasters are probably among the earliest built in this country and some of the others are modern and up-to-date.

The estimated total tonnage for the district calculated to 100 per cent sulphuric acid, is 290,000 tons per year. The manufacturers market sulphuric acid in various concentrations ranging from 60 deg. Bé. acid to 25 per cent oleum.

Nitric acid in various concentrations from 36 to 43 deg. Bé. is produced by five different manufacturers. All of the nitric-acid plants in the district are of the older type. They are either cylindrical stills or pot stills of the Valentiner type, and the condensing equipment is of earthenware. There is not a single nitric acid-plant in the district of the type built and operated in the period 1914 to 1918.

Many Obsolete Acid Plants

The plants, as has been said, have been built a long time. The manufacturers have not been called upon to produce nitric acid in excess of their capacity and, therefore, no new, up-to-date plants have been projected, in fact, one unit of one of the plants such as was built during the war would supply the entire nitric-acid tonnage of the district.

The raw materials for manufacture are imported sodium nitrate and sulphuric acid made in another part of the same plant. The writer knows of no nitric-acid plants in the district that are not also producers of sulphuric acid. The quantity of acid made, calculated to 100 per cent HNO_3, is estimated to be approximately 6,000 tons per year.

Hydrochloric acid in concentrations of from 18 to 20 deg Bé. is produced by five manufacturers. The hydrochloric-acid plants, like the nitric-acid plants, are in the main, old timers. There is one plant in the district which is reasonably up-to-date. There is not, however, one plant in the district which employs the latest types of equipment in this line of manufacture.

The customary raw materials in these plants are acid sodium sulphate and sodium chloride. The acid sodium sulphate comes from the nitric-acid department and the sodium chloride is shipped in from Michigan.

The quantity of acid made in the district per year, calculated as 18 deg. Bé. is approximately 25,000 tons.

Acetic acid in various concentrations from 30 per cent to 100 per cent is produced by two companies. The raw materials of manufacture are acetate of lime coming primarily from Michigan wood-distillation plants, and

sulphuric acid. The process used is the customary batch process and the volume of acid produced is not great. The author knows of no plant treating the calcium acetate with hydrochloric acid, although the available census reports state that this is the process most used in the manufacture of acetic acid.

Wide Variety of Chemical Producers

Sodium Compounds. Salt cake or sodium sulphate is produced by four companies and most of it is used as a raw material in the manufacture of other products. Some companies market a portion of their product as technical salt cake containing 95 per cent Na_2SO_4, and some purify part of the technical product and market it as C. P. crystals.

Sodium silicate is produced by two manufacturers and is marketed in solutions of various concentrations ranging from 38 to 42 deg. Bé., and some of it is also sold as solid sodium silicate. The raw materials for manufacture are Ottawa sand and sodium carbonate or Ottawa sand, sodium sulphate and carbon. Both processes are used.

Sodium thiosulphate is produced by one establishment. This plant is a comparatively recent one, well built and well operated, and produces a considerable tonnage of sodium thiosulphate which is marketed as U. S. P. crystals.

Sodium sulphide is produced in two establishments and is marketed in 20 per cent solution, 60 per cent solution, and 60 per cent solid chips. This product is used mainly by the tanners in this and adjacent districts.

Zinc chloride is produced by two manufacturers and is marketed in solution in concentrations of 53 and 58 deg. Bé.

Ammonium compounds. Ammonium sulphate is produced by seven different manufacturers as a by-product from the coking of coal. It is marketed as technical ammonium sulphate. The quantity produced per year in the district is approximately 70,000 tons. Its chief use is as a fertilizer. A comparatively small amount is used by establishments in this district producing anhydrous ammonia.

Anhydrous ammonia is produced by three firms in the district. This is made from purchased ammonium sulphate and is used primarily for refrigeration processes by the companies producing it. It is also sold for the same purpose.

Aqua ammonia is produced by two manufacturers and marketed as 30 per cent technical and 30 per cent C. P.

Phosphates and Borates. The following phosphates are produced by one firm which operates in a fairly large way on these chemicals: calcium phosphate, mono ammonium phosphate, and di-ammonium phosphate. mono sodium phosphate is made by two firms both of which produce a rather large tonnage of this material. One of the plants has been put in operation during the past year and is a model plant of its kind.

Sodium biborate and boric acid are produced by one firm. This firm brings together in Chicago, colemanite from California and sodium carbonate from Michigan to produce the sodium biborate. The sodium biborate acidified with sulphuric acid yields the boric acid.

Aluminum sulphate is made by two firms in this district. This is the only alum made in the district so far as the writer is able to discover.

Chlorine and Alkalis. There are no firms in the district covered by this report who produce chlorine, nor are there any firms "producing chemicals by the aid of electricity," as tabulated in the U. S. census report.

There are no establishments in Indiana or Illinois producing sodium carbonate or sodium bicarbonate.

Paint Industry a Chemical Producer and User

There are five establishments in this district producing white lead. Three processes are used, the Dutch process, the Carter process, and an electrolytic process. The quantity produced in the five establishments is approximately 35,000 tons per year. It is marketed as dry white lead, and as white lead paste, i.e., ground with linseed oil. Some of the producing companies use most, if not all, of their product in making paints which are marketed under their own labels.

Lithopone is produced by three firms in this district. The producers ship in barium sulphate from Missouri and Arkansas and use scrap zinc purchased locally as a source of the zinc. Three firms produce zinc oxide. The zinc ore utilized by these producers comes from Missouri, Kansas and Oklahoma. A considerable quantity of Wisconsin ore was formerly used by these establishments, but is no longer available.

There are two producers of red lead in the district and one producer of litharge. Chrome green is produced by two establishments and chrome yellow by the same number. There are four producers of Prussian blue. Organic lakes of various descriptions are manufactured by three establishments.

This district has always been one of the country's largest producers of paints and pigments. The pigments previously mentioned are mainly used in the district in preparing paints for market. A very large percentage of the paints made in the country are produced and marketed in this district.

There are three large producers of lead arsenate in the district and the same number of establishments produce calcium arsenate. These are marketed both as paste and dry powder. Lime sulphur solution is made by four large producers. There are two large producers of Bordeaux mixture in the district. This is also marketed both as paste and dry powder.

There is a considerable number of small firms making insecticides and fungicides for a distinctly local market and it is impossible to obtain anything in regard to their number or extent of their operations. The establishments referred to here are among the largest in the country.

Among Chemical Consumers

Petroleum refining is one of the large chemical consuming industries of the district. There are three large petroleum refineries in Illinois and two in Indiana, one of the Indiana refineries being among the largest in the country. There are a number of other small establishments which by courtesy, might be termed petroleum refineries. The Indiana plant has been almost entirely rebuilt in the last fifteen years and embodies some of the latest and best construction in this industry.

The raw materials handled in these refineries come by pipe line and chiefly from Kansas, Oklahoma and Texas. Only a small amount of oil from Indiana and Illinois is any longer obtainable. The products of these refineries are marketed almost entirely in the localities in which they are produced.

There are about forty plants in this district producing

glass of various kinds, but mainly glass containers. This industry has a production value of about $60,000,000 per year. The raw materials used are Ottawa sand, lime and sodium carbonate. The largest of the plants are adjacent to the sand supply and are compelled to ship their lime and sodium carbonate from some distance.

There are three companies operating in the district manufacturing the various products derived from corn, such as starch and its alteration products, corn oil, glucose, anhydrous dextrose, and stock foods.

Large Potential Output of Coal-tar Crudes and Intermediates

The byproduct coke ovens in this district have a potential capacity of 31,500,000 tons of coal coked per year.

There are three tar distilling plants treating only a small amount of tar which is produced in these coke ovens. Assuming that all of the byproducts from the coal coked in the district were treated in these tar distilling plants and that the byproducts from the gas made in the coke ovens was recovered, there would be a potential capacity in the district of coal-tar crudes as follows:

Benzol	70,625,000 gallons
Toluol	16,663,000 gallons
Solvent naphtha	5,060,000 gallons
Naphthalene	41,680,000 pounds
Phenol	99,540,000 pounds
Anthracene	4,977,000 pounds
Tar	237,455,000 gallons

The total tar products available in this district exceed in every instance except the one item of tar, the total country's production in these items as given in the Tariff Commission's census of dyes and other synthetic chemicals. The three companies operating in the district, however, recover and refine only a small percentage of the materials which are available.

These three companies produce primarily a mixture of benzol, toluol, and solvent naphtha which is sold for motor fuel, crude and refined naphthalene, phenol, cresol, cresylic acid and coal tar pitch in various grades and consistencies.

There are only four plants in the district that purchase coal-tar crudes and make from them intermediates, dyestuffs and synthetic organic chemicals. All of these plants, with one exception, operate in a small way and make only a very limited number of products.

One company in the district has been in operation thirty-four years, has 550 employees and produces a diverse line of pharmaceutical and medicinal chemicals. This company's products for 1926 had a value of $2,500,000 and is estimated to have operated at about 65 per cent of its total capacity. The quantity of these chemicals varies from 100 pounds to 25,000 pounds annually.

Another company operating in a fairly large way, makes a few dyestuffs and organic lakes for their own use and for sale to be used in paint manufacture.

The other companies making synthetic organic chemicals produce only a limited number of products.

There are two companies connected with the packing house industries that manufacture gland substances, animal derivatives, digestive ferments, ligatures and sutures. These companies employ about 125 people and the combined value of their products for 1926 is something over $1,000,000.

It has elsewhere been noted that there are no companies in the district making caustic or carbonate alkalis. Recent census returns show that this district uses annually about 10,000 tons of caustic soda and about 15,000 tons of sodium carbonate. Salt for the production of both of these chemicals is easily available at a low price at lake ports on Lake Michigan, can be transported cheaply by boat to the Chicago district and there made into either caustic or carbonate.

These statistics show that there is no chlorine produced in the district and there would, therefore, be a market for both the caustic produced and the chlorine. This is one of the chemical industries which, to the writer, seems well worthy of attention of those who might be interested in establishing a new industry in the district.

This district has also been one of the country's largest producers of clear varnish and varnish enamels. The woodworking and finishing industries here are among the largest in the country and this has always been a large distributing point for this class of goods.

It seems eminently desirable, now that the tendency in wood finishing is to replace varnish with lacquers, that this district become a large producer of the various types of clear and enamel lacquers. This has as yet not been brought about, although large quantities of the most satisfactory lacquer solvents are produced in the district and at satisfactory prices. The district at the present time produces no nitrated cotton although all of the materials required, excepting cotton linters, are readily available.

There are two large firms in the district producing lacquer solvents. One of these plants has been in operation for twelve years and the other for six years. The combined capacity of these plants is about 7,350,000 gallons of solvent annually, the total value of which is about $9,000,000. The plants are stated to have operated at about 85 per cent of their capacity in 1926.

It is the author's opinion that such chemical manufacturing as is represented by the acid and heavy chemicals has sufficient capacity to meet the demands of the district.

Opportunities for New Industries

The industries which seem to offer the most promise to companies looking for opportunity to expand, or looking for the location for a new plant, are those of alkali production, both caustic and carbonate, the production of lacquers, solvents and plasticizers, and the production of certain refined organic chemicals which can be made in a comparatively small way and to meet a specific local demand.

Some of the factors which should attract these chemical industries to this district, are cheap and abundant fuel, satisfactory water supply, reasonably good labor conditions, and excellent transportation.

But the two points of the greatest attraction which the writer wishes to emphasize are cheap and abundant electricity and cheap and abundant gas supply. There is no place in the country where current is put on the wire at a lower manufacturing cost than throughout this district, yet as has been elsewhere noted in this article, there are said to be no chemicals produced in the district by the aid of electricity.

The writer is indebted to Assistant Professor John J. Schommer and to his entire senior class for their very kind assistance in gathering together the statistics of this article.

Development of TENNESSEE *Valley Centers Around Sulphuric Acid Production*

Raw materials of this district are coal, phosphate rock, sulphide ores, and limestone
Large undeveloped water powers are available for industrial use
Sulphuric acid production is large, a single plant producing 1,100 tons per day

By W. H. Scott
The Duriron Co., Inc., Dayton, Ohio

POSSIBLY the most important industry in the states of Kentucky and Tennessee and especially in the latter named state, is the production of sulphuric acid, a goodly portion of which is used in the manufacture of acid phosphate. The outstanding plant is that of the Tennessee Copper Co. at Copperhill, Tenn., which is credited with a possible daily production of 1,100 tons of 60 deg. Bé. acid in 24 hours. This company also concentrates about 100 tons per day of acid from 50 to 66 deg. Bé. This company also makes copper sulphate.

Within a few miles of Copperhill at Isabella, Tenn., is the plant of the Ducktown Chemical and Iron Co., formerly the Ducktown Sulphur, Copper & Iron Co. This plant has a daily capacity of 200 tons of 60 deg. acid per 24 hours and is used almost wholly in the manufacture of acid phosphate. There are two sulphuric acid chamber plants at Nashville, Tenn., with a total capacity in excess of 100 tons per day, practically all of which is used in the manufacture of acid phosphate. In the state of Tennessee there are ten plants making acid phosphate from phosphate rock and sulphuric acid with an average capacity of 50,000 tons per year.

The phosphate rock is supplied mainly from the phosphate rock district in Tennessee south of Nashville, while the sulphuric acid is made either in a chamber plant run in connection with an acid phosphate and fertilizer department or is purchased from the Tennessee Copper Co. at Copperhill.

In addition to the fertilizer plants producing acid phosphate there are a number of dry mixing plants buying all of their ingredients ready made from outside sources. There is only one acid phosphate plant in the state of Kentucky, which is in Louisville. There are also a half dozen dry mixing plants in Louisville producing ready mixed fertilizer. In the vicinity of Louisville, Ky., and Nashville, Tenn., there are located textile finishing plants, specializing in bleaching and finishing gray goods. These plants use sulphuric acid and bleaching powder or make their own hypochlorite with liquid chlorine and lime.

East Tennessee has a number of knitting mills, both hosiery and underwear. The largest finishing plants are at Chattanooga. At Chattanooga also are located two large mercerizing plants using quite a volume of sulphuric acid which in the main comes from Copperhill, Tenn. At Chattanooga there is a byproduct coke plant producing ammonium sulphate and refined benzol. The production of ammonium sulphate will not exceed 5 tons per day. At Nashville also a half ton ammonium sulphate plant is being erected.

There are a half dozen small petroleum refineries in the state of Kentucky using appreciable quantities of sulphuric acid and hypochlorite. There are no petroleum refineries in the state of Tennessee.

Tennessee has two fairly large rayon plants. The DuPont plant near Nashville produces viscose silk using cotton linters as a source of cellulose, sulphuric acid for coagulating and carbon bisulphide. At Elizabethtown, Tenn., is the new plant of the Bemberg Corporation, using a modification of the cupra-ammonium process.

Largest Insecticide Plant in South

The largest insecticide plant in the southern states is located at Memphis, Tenn., having a production capacity of 30 tons of calcium arsenate per 24 hours. This plant buys its lime on the open market and nitric acid is purchased in carboys from the nearest convenient production point, where the price happens to be attractive.

At Clarksville, Tenn., is a plant for the production of nicotine sulphate using sulphuric acid and stems or other refuse from tobacco factories. Another such plant is located at Louisville, Ky., and a third one at Henderson, Ky.

Memphis, Tenn., has two large cottonseed oil mills and cottonseed oil refineries. Chattanooga has two such plants also. All these plants produce cottonseed meal, refined cottonseed oil, cooking oils and shortenings or lard substitutes. At Memphis is located one of the two plants making paper from cottonseed fibers. The other such plant is located in Augusta, Ga. At Chattanooga is a plant for conditioning cotton linters which are shipped to rayon plants to be made up into artificial

silk. There is also a pulp and paper plant at Kingsport, Tenn., using hard woods as a source of cellulose.

There are a number of metal cleaning plants using acid baths for pickling, in the states of Kentucky and Tennessee, located at Chattanooga, Nashville, Ashland, Newport, and Dayton, using quite a volume of sulphuric acid for acidulating the pickling bath. This sulphuric acid comes from the nearest manufacturing point or from the Tennessee Copper Co.'s plant, depending on price. Tennessee has several fairly large portland cement plants. These are located at Chattanooga, Nashville, Memphis, and Kingsport. Kentucky does not produce any portland cement to speak of. Louisville has one dry color plant where small quantities of muriatic acid are used. This plant, owned by the Kentucky Color and Chemical Co., was established in 1919 and since that time has manufactured pigment colors that are distributed over the entire country for use in paints and printing inks. It is said to be the only plants of its kind south of the Ohio River and is the largest west of New York. The same company operates a coal-tar distillery, producing creosote oil, pitch, wood preserving oils, tar acid oils and disinfectants.

Industrial Consumers of Chemicals

A number of other chemical-consuming industries are to be found in and around Louisville. There are two enameling works producing bath-tubs, sinks and similar enameled ware by the dry process. A wet process plant is being erected in the district and will be devoted to enameling of stove castings and similar work. Eleven paint factories, six varnish plants, six tanneries and a creosoting plant treating bridge timbers, railroad ties and similar materials form another group of chemical users. Louisville is the home office of the American Creosoting Co., which controls a number of plants throughout the United States and Canada although operating only the one plant in this state.

The canning industry is not very well developed in these two states, the plants being mostly small and of local character. There is a large plant at Nashville producing baking powder bases from phosphate rock and sulphuric acid. This plant of the Victor Chemical Co. produces its own sulphuric acid for acidulating the rock.

Chattanooga does quite a bit of enameling, having two fairly large plants for the production of enamelware, also a plant for the production of aluminum sulphate, sulphuric acid for this purpose coming from Copperhill and the bauxite from Tennessee or Georgia. The product of the plant is sold to paper plants and to water filtration plants. There is a large quantity of tannic acid produced in the state of Tennessee principally at Chattanooga and at Knoxville. Nashville also has a small plant. An appreciable amount of leather, especially oak tanned sole leather, chrome harness and saddle leather is made in Chattanooga, there being two fairly large plants for production of such articles.

The Grasselli Chemical Co. is building a sulphuric acid contact plant at Greenup, near Ashland, Ky. This plant is being built with a view of supplying the steel mills in that section with sulphuric acid for metal pickling and will also be a convenient source of supply for byproduct coke oven plants. Eastern Kentucky and Tennessee are both very deficient in the possible number of byproduct coke ovens, which seem to be justified by economic conditions in the two states. Memphis and Chattanooga are both fairly large centers for the production of proprietary medicines. Chattanooga especially, has several very large plants producing nationally advertised preparations for both man and beast.

Development of Muscle Shoals just across the Tennessee line in Alabama would go a long way towards developing the extensive phosphate rock deposits in south central Tennessee and would give a considerable impetus to the manufacturing industry, in Chattanooga and in Memphis.

The outstanding raw materials in the two states suitable for manufacturing chemicals, are coal, phosphate rock, sulphide ores and limestone.

The transportation system of the two states is well developed, practically all sections having adequate railroad facilities and traction lines. The highway development is somewhat slow.

The eastern part of the states especially is well favored as to labor conditions, there being an almost inexhaustible supply of intelligent, native-born American labor which can be quickly and easily trained. The eastern part of the states is also well favored as to power, both steam and water, and developments of magnitude may be looked for in this section of the two states.

Lead and Zinc Pigments show Increased Use

Steady activity of the lead and zinc pigments industries in 1925 is shown in the Bureau of Mines report by J. A. Stader and A. Stoll which has just been released. Large aggregate sales were reported by the domestic producers. All lead pigments sold at higher average prices per ton than in 1924 but the average selling price of two zinc pigments, lead-free zinc oxide and lithopone, declined $8 and $10 per ton, respectively. Much larger sales in 1925 made the total value of these two pigments over $4,000,000 more than in 1924.

The quantities of lead and zinc pigments sold by domestic manufacturers in the United States since 1916 are shown in the following tables:

Lead Pigments Sold by Domestic Manufacturers in the United States, 1916-1925 in Short Tons

	White Lead		Basic Lead Sulphate or Sublimed Lead				
Year	Dry	In Oil	White	Blue	Red Lead	Orange Mineral	Litharge
1916	32,938	96,041	10,977	1 287	[1] 23,035	(1)	37,739
1917	27,869	87,331	8,231	1,369	[1] 25,478	(1)	44,102
1918	20,089	82,799	7,403	1,343	[1] 30,069	(1)	48,874
1919	30,085	109,005	9,068	1,350	[1] 32,362	(1)	46,739
1920	33,678	112,017	12,412	928	[1] 34,431	(1)	62.329
1921	26,738	143,545	11,568	463	21,805	381	41,909
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107
1924	42,622	144,872	14,572	1 088	36,813	331	74,724
1925	43,426	120,479	14,996	1,090	41,669	840	86,546

[1] Figures for red lead include orange mineral prior to 1921.

Zinc Pigments and Salts Sold by Domestic Manufacturers in the United States, 1916-1925, in Short Tons

Year	Zinc Oxide	Leaded Zinc Oxide	Lithopone	Zinc Chloride (50° Baumé)	Zinc Sulphate
1916	100,339	23,003	51,291	(1)	(1)
1917	107,586	23,450	63,713	(1)	(1)
1918	100,286	26,714	62,403	(1)	(1)
1919	117,639	27,591	78,365	[2] 59,228	[2] 2,763
1920	99,444	30,460	89,373	[2] 68,945	[2] 3,072
1921	74,329	16,103	55,016	59,457	3,295
1922	128,465	19,613	83,360	41,627	5,078
1923	126,987	23,504	98,199	42,431	5,375
1924	131,470	26,729	109,469	51,054	4,674
1925	151,354	31,750	145,019	45,619	5,332

[1] No canvass. [2] Figures cover production, not sales.

KANSAS CITY *District Holds Promise of Important Chemical Developments*

By Roy Cross

Consulting Chemical Engineer, Cross Engineering Company, Kansas City, Mo.

FOR THE PURPOSE of this survey the Kansas City district may be understood to cover western Missouri and all of the states of Kansas and Nebraska, with a population of five million people. This district is primarily agricultural, producing and utilizing principally cereals and cereal products. The annual cereal crop alone of this territory amounts to approximately 1,100,000,000 bu., which is equivalent to 40,000,000,000 lb. of starch, 15,000,000,000 lb. of vegetable oil and approximately 500,000,000 tons of cellulose.

The principal industries which consume chemicals are as follows:

(1) The meat packing and slaughtering industries with an aggregate value of products amounting to $550,000,000. This industry slaughters 8,000,000 head of live stock per year and the principal chemicals consumed are sodium chloride, sodium nitrate, sodium nitrite, soda ash, lime, caustic soda, sodium sulphide, sulphuric acid, muriatic acid, phosphates, potash, sulphur, ammonia, calcium chloride, fullers earth, alum, calcium phosphate, zeolite, calcium sulphide, disinfectants, soaps, lactic acid and pyroligneous and refined acetic acids.

(2) Flour and cereal mills with a total value of products of $200,000,000. This industry comprises the milling and extraction of the products of wheat and corn, including flour, stock foods, corn oil and syrup. The principal chemicals consumed are chlorine, muriatic acid, benzoyl peroxide, caustic soda, soda ash, lime and sucrose.

(3) Petroleum refining with an annual value of products amounting to $125,000,000. The principal chemicals consumed are sulphuric acid, caustic soda, lime, bleaching powder, litharge and fullers earth.

(4) Creameries and milk condensing plants with an annual value of products amounting to $75,000,000. The principal chemicals consumed are caustic soda, sodium hypochlorite, soda ash, sodium phosphate, salt, sulphuric acid and muriatic acid.

(5) Baking and cracker manufacture with a total annual value of products amounting to $45,000,000. The principal chemicals consumed are salt, sodium bicarbonate, sodium phosphate and organic acids.

(6) Soap, glycerine and related chemical industries with a total annual value of products amounting to $30,000,000. The principal chemicals consumed are caustic soda, soda ash, lime, salt, iron sulphate, fullers earth, sodium silicate, synthetic oils, fatty acids, sulphuric acid, muriatic acid and calcium chloride.

(7) Cement manufacture with a total output of 11,000,000 bbl. annually and of a value of $20,000,000. The principal chemical used, outside of the limestone and aluminous shale, is calcium sulphate.

(8) Clay products and refractories with an annual value of products amounting to $15,000,000. The principal chemicals used are salt and lime.

(9) Paint and varnish manufacture with an annual value of products amounting to $15,000,000. The principal chemicals used are zinc oxide, white lead, lithopone, metal soaps, painter's naphtha, benzol, acetone, toluol, butanol, xylol, ethyl acetate, butyl acetate and all types of drying oils and mineral pigments.

(10) Smelting and metal refining with an annual value of products amounting to about $15,000,000. The principal chemicals used are lime, acids, zinc, lead and white metals.

(11) Drugs, patent medicines and chemical disinfectants with annual value of products amounting to about $5,000,000. The principal chemicals used are cresols, phenols, caustic soda, soda ash, lime, rosin, linseed oil, sulphur, arsenicals, formaldehyde, zinc chloride and the usual innumerable drugs and chemicals in small quantities.

Other Consuming Industries

Other important industries consuming chemicals include strawboard and paper box mills, tanneries, water softening plants, steel and wire mills, foundries, disinfectant and spray compounders, ink manufacturers, battery companies, cold storage warehouses and other industries common to all districts in proportion to the population.

The principal chemicals consumed in the above and other industries in this territory, with the annual amounts and sources, are cited in Table I.

Table I—Source and Quantity of Principal Chemicals Used in Kansas City District

Substance	*Amount*	*S urce*
Sodium chloride or salt	500,000 tons	Kansas
Caustic soda, soda ash, etc.	50,000 tons	Imported to district
Sulphuric acid	30,000 tons	Kansas City
Hydrochloric acid	10,000 tons	Kansas City and imported
Sodium nitrate	500 tons	Imported
Sulphur	15,000 tons	Texas
Lime	150,000 tons	Western Missouri
Alum	25,000 tons	Local and imported
Naphtha and gasoline	15,000,000 barrels	Kansas City, Okla. & Kansas
Benzol	70,000 barrels	Imported
Tuluol and Xylol	70,000 gallons	Imported
Denatured alcohol	50,000 barrels	Imported
Nitric acid	100 tons	Kansas City and imported
Lithopone	10,000 tons	Imported
White lead	2,000 tons	Missouri and imported
Zinc oxide	500 tons	Imported
Organic solvents	200,000 gallons	Imported
Calcium sulphate	100,000 tons	Kansas and imported

Other chemicals used in considerable quantity include:

Sodium nitrate	Cresylic acid	Copper sulphate
Chlorine	Aluminum stearate	Ethylene dichloride
Bleaching powder	Sulphur chloride	Carbon tetrachloride
Sodium bicarbonate	Carbon bisulphide	Magnesium silico-fluoride
Sodium sulphide	Glycerine	Potash salts
Ammonia	Sodium sulphate	Acetic acid
Iron sulphate	Formaldehyde	Zinc chloride
Calcium chloride	Calcium carbide	Carbolic acid
Ammonium nitrate	Barium sulphate	Lactic acid
Calcium carbide	Lead oxides	Tartaric acid
Acetylene	Fullers earth	Acetone
Sodium phosphate	Sal ammoniac	Potassium chlorate
Sulphur dioxide		

Little Growth Among Chemical Producers

The chemical manufacturing establishments of this district have a total annual output of approximately the value of $50,000,000, and there has been very little recent development. Most of the plants have been operating for a considerable period of time.

Sulphuric acid is produced to the extent of approximately 50,000 tons per year and there have been no recent plants established. The production is sufficient to supply the local markets, the sulphur being shipped in from outside of the territory. The only product obtained locally for use in acid plants is salt.

Cement mill capacity has increased slightly during the past two years but most of the plants have been operated at close to full capacity, producing about 11,000,000 bbl. per year. At almost every point in this territory the raw materials entering into the cement are available. Practically all of the plants have changed from oil heating to powdered coal, the coal coming principally from the district near southeastern Kansas.

Petroleum Refining Growing

Petroleum refining has existed ever since crude oil was first found in this territory. The annual throughput of refineries is constantly growing, amounting now to approximately 45,000,000 bbl. annually. The production of all oil products is considerably in excess of consumption, the excess being shipped to northern and eastern points. All of the usual products are made, including gasoline, painter's naphtha, cleaner's naphtha, rubber solvent, illuminating oils, lubricating oils, domestic distillate, stove oil, gas oil, fuel oil, wax, absorber oil, asphalt, mineral rubber and brick filler.

The manufacture of lime is such as to balance almost exactly the consumption. The present annual production amounts to 150,000 tons. An unlimited quantity of high grade limestone is available.

Alum is used most largely in water filtration plants, and only recently has it been manufactured in this district. The manufacture now is most largely by water companies that use it themselves. The annual capacity of these plants is at least 5,000 tons. Bauxite and sulphuric acid are the raw materials used.

Soap and glycerine are manufactured on a fairly large scale, the plants having been established for a long time, the location being dependent most largely upon the supply of raw materials, including cottonseed oil, animal fats and fatty acids. Sodium silicate is extensively manufactured chiefly for the soap industry but also for the glue and box industries.

Corn Products a New Industry

The manufacture of corn oil and corn syrup is relatively new in this district, one large plant having a daily grinding capacity of 20,000 bu. of corn and having a producing capacity of about 1,000,000 lb. of corn syrup per day and something over 40,000 lb. of corn oil per day.

The total amount of salt produced, including refined salt, is 800,000 tons, this being dependent upon the ample supply of raw material and its extensive use in the meat packing industries.

There is a small capacity in the refining of zinc and lead ores and the production of zinc and lead pigments and chemicals.

Most of the other chemicals manufactured in this district are made on a very small scale. They include synthetic oils, explosives, acetic acid, fatty acids, nitrous oxide, oxygen, hydrogen, ethylene, acetylene and organic extracts.

Attractive Resources, Power and Transportation

The most attractive features in this territory, in respect to possible chemical manufacturing, are dependent upon the more important primary natural resources, from which the annual production is shown in Table II.

Table II—Annual Production of Principal Natural Materials of Kansas City District

Cereals	1,100,000,000	bushels
Cellulose byproduct	500,000,000	tons
Crude petroleum	40,000,000	barrels
Gasoline	22,000,000	barrels
Natural gas	27,000,000,000	cu.ft.
Casinghead gasoline	10,000,000	gallons
High grade bituminous coal	8,000,000	tons
Hides	8,000,000	
Gypsum	250,000	tons
Lead	40,000	tons
Zinc	130,000	tons
Salt	800,000	tons
Stone, sand and gravel	7,000,000	tons
Barytes	80,000	tons
Clay, including diaspore and bauxite	500,000	tons
Pumice and tripoli	50,000	tons
Marble	670,000	cu.ft.
Limestone	3,000,000	cu.ft.
Potash	340	tons

Power Resources

The annual power development, using fuel as source, amounts to approximately 1,000,000 hp., the power capacity in Kansas City being about 250,000 hp. The average price of coal in this district at the mine amounts to about $2.88 per ton, the coal from southeastern Kansas being of exceptionally high quality.

The amount of water power actually developed is something over 30,000 hp. and the plants under way are figured at 70,000 hp.

The principal transportation services available at this time are the railroads which converge to points on the eastern edge of the district, making distribution particularly easy. Missouri and eastern Kansas are now thoroughly served with a new concrete road system costing approximately $100,000,000. The Missouri road system particularly has made otherwise useless natural

resources easily available. An available future asset lies in the fact that the district is bounded on the east by the Missouri River. Developments are now under way for the permanent control of the river so that it will be navigable for all times except two months in the winter.

The remoteness from the borders of the country (for this district is the geographical center of the United States) results in the fact that labor is almost entirely American. This type of labor is particularly suitable for handling machinery and for high-class manufacturing. Living conditions are excellent, due to the abundance of agricultural products, the excellent school systems, the availability of oil and natural gas fuels and the absence of excessively cold or wet weather conditions.

Lines of Future Development

Important future developments in chemical industries apparently should be along the following lines:

1. Manufacture of paint pigments. Materials of this sort are not manufactured in sufficient quantity to supply even the local trade. Barium sulphate, zinc ore and petroleum carbon, the basic materials used for the manufacture of lithopone, are available in unlimited quantities, although lithopone is largely imported from outside the district. The same may be said of practically all other paint pigments.

2. Caustic soda and chlorine: Practically all of the requirements for the manufacture of caustic soda and chlorine are to be found here. There is a large consumption of caustic by the soap manufacturers, packing houses and other industries, as well as a large consumption of chlorine by the flour millers, petroleum refiners and disinfectant manufacturers. Power may be had at a quite reasonable rate and in all probability future power plants will provide even cheaper power.

3. Electric Power: Additional power sources may be had from the streams in the Ozark district, particularly from the Osage river where a $20,000,000 project is proposed. The estimated hydroelectric power exclusive of the Missouri River that can be economically developed in the district is 250,000 hp. A site for a power project on the Missouri River north of Kansas City is available which is capable of delivering nearly as much power as the Keokuk dam.

Enormous quantities of cheap coal are available in the southeastern Kansas coal district, and this district is rapidly developing following a long period of labor troubles which have now been completely settled. Enormous resources of both coal and oil are known to exist throughout a large portion of the state of Kansas. Large quantities of oil have already been discovered in northwestern Kansas, supplying that locality with much needed fuel.

Large quantities of gas are available in southwestern Kansas, and a project is now under way for delivering industrial gas to Kansas City from the Texas Panhandle.

4. Tanning of leather is carried on to only a limited degree, although there is an abundant supply of both tanning materials and hides. The leather industry in general is moving westward and is just starting in this district. There is probably a good future in the tanning industry and the development of chemicals suitable for treating hides and leather.

5. Aluminum compounds, such as sodium aluminate, alum, quick hardening cement and refractories, offer possibilities due to the large deposits of diaspore and bauxite. Diaspore is becoming particularly valuable for the production of refractory materials for furnaces. Limestone and cheap power are available in conjunction with the diaspore for calcium aluminate cement.

6. The petroleum fields of western Kansas that are just now developing are characteristic in being of a pure paraffine base nature. The crude oil from this pool is the only source west of Pennsylvania district for the manufacture of butane, refrigerants, petroleum ether, pure paraffine naphtha and similar hydrocarbons with their derivatives.

7. Cellulose from straw and corn stalks is available in unlimited quantity. It is probable that 500,000,000 tons of such material could be collected. Such material is being used almost exclusively in Italy today for the manufacture of all types of paper. It is available also for the manufacture of alcohol, artificial lumber, building papers, building boards and insulating materials, with the proper chemical and physical treatments. The only utilization of straw at this time is for the purpose of making straw board as filler for paper boxes.

8. Coal carbonization: The coals of southeastern Kansas are particularly suitable for coal carbonization. By distillation at low temperatures very high yields of cresols and anti-knock blending naphtha for motor fuels are obtainable. At the same time the semi-coke made is particularly useful for household fuel and would readily displace practically any of the fuels now available.

9. The special development of sugar producing crops, such as sugar beets and the Jerusalem artichoke has been suggested. Much of the territory in the states of Kansas and Nebraska is ideally suited for this type of agriculture. The Jerusalem artichoke would yield considerable amounts of levulose and the beet will yield cane sugar. These are ideal sweetening agents for corn sugar. At the present time there is rather extensive development in the beet sugar industry around a large refinery in southwestern Kansas and this, in all probability, could be greatly extended.

10. Helium: Helium was first discovered in Kansas natural gas by Cady and McFarland more than twenty years ago. Much gas is available in southern Kansas containing up to 2 per cent of helium. A production of 50,000 cu.ft. per day is apparently possible.

11. Solvents may be made from the byproduct gases of oil cracking plants, now used only as fuel. These gases contain ethylene and other hydrocarbons from which ethylene dichloride, isopropyl and other alcohols, purified ethylene, formaldehyde and other chemicals may be made. Acetone and alcohols may also be made by the fermentation of cereals.

The sources of information for this summary were as follows:

Files of the Kansas City Testing Laboratory
Prof. P. F. Walker, University of Kansas
K. K. Landes, Acting State Geologist of Kansas
H. A. Buehler, State Geologist of Missouri
United States Census publications
Publications of Kansas State Agricultural Department
Publications of Bureau of Mines
Publications of United States Geological Survey
Various purchasing agents of industrial organizations in Kansas City
Kansas City Chamber of Commerce.

Farm Byproducts of IOWA *Invite Chemical Engineering Projects*

By O. R. Sweeney

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THE state of Iowa is not an important producer of chemicals, nor is it a large consumer of heavy chemicals. The state of Iowa excels in the value of farm products produced in the United States. Naturally a large number of industries have sprung up using the farm product as a raw material and further similar developments are assured.

As an idea of the magnitude of the agricultural industry, the annual value of cattle in the last few years has been about $117,000,000, of the hogs $125,000,000; 720,000,000 bushels of grain have been produced, but of course most of this has been fed to live stock.

The most important present chemical engineering industries are the corn products plants at Clinton and Cedar Rapids. These plants make starch, dextrin, dextrose, corn syrup and stock food and are among the largest in the world. The slaughter houses, which are only moderately large plants as compared with the great centrals of Chicago and Kansas City, are users of considerable quantities of chemicals, although no statistical data are available. The slaughtering and meat packing industries produce $155,000,000 of goods annually.

The value of the cereals produced into cereal foods is estimated at $40,000,000. Corn syrup, corn oil and starch are estimated at an annual value of $20,000,000. The soap produced annually in Iowa has a value of $1,700,000. Evaporated and condensed milk have a value of $1,500,000.

The value of the unclassified chemicals is estimated at $2,000,000 for 1920. Paper and wood pulp produced in the state is about $2,000,000. The electroplating industry is estimated at $70,000. The patent medicine industry, which uses considerable quantities of chemicals, is rated at $4,500,000 annual value. The rubber industry has an output valued at $3,500,000. The lime and cement products are valued at $12,600,000.

A distinctive and novel industry in the United States is that of furfural manufacture. The only plant in the United States and the only plant of any magnitude in the world is in Cedar Rapids. This plant is capable of producing 5,000 lb. of furfural per day and probably produces $155,000 worth of chemicals per year. The material is made from oat hulls, which are a byproduct of the oatmeal industry.

The annual production of the gas industry is 2,000,000,000 cu.ft., worth $7,350,000. Considerable quantities of gas tar and coal tar are recovered in this industry, but no figures are available as to the amount.

Corn as a Chemical Raw Material

The most important chemical industries in the state are the corn products and the gypsum industries. The future chemical development of Iowa depends largely upon the utilization of agricultural products. It is a fact that today the value of corn would average about 58c. a bushel if it could be sold. This same bushel of corn, when fed to cattle and swine, returns a yield of about a dollar a bushel to the farmer. If converted into starch, syrup, dextrin and various other products, a bushel of corn will yield about $2.30. If fermented into butanol, acetone and ethyl alcohol, the products are worth about $4.60.

It can be seen from this that the agricultural raw materials have a splendid outlet through the chemical industries, provided a market can be found for the large number of materials which can be made from it.

In the large region which is technically known as the "corn belt," the most profitable material that can be grown is corn. The state of Iowa is practically 100 per cent corn land. In order to grow corn successfully, however, it is necessary to rotate or rest the land with other crops. The most satisfactory material yet found for this purpose is the soya bean. It can be shown that if the soya bean be converted into protein stock food and soya-bean oil, the yield on the capital investment in such a plant will be large.

At the present time efforts are being put forth to establish this industry and already a number of plants have been put in operation. In as far as this oil is suitable, there is no question but that the corn belt

can supply the oil needs of the country. Of course soya bean oil will not substitute for all of the oils, but it will in large measure. Not only is the protein matter a splendid stock food for which there is ample market, but it also gives promise of being a splendid raw material for a substantial chemical industry.

Perhaps the entire future of the corn belt region and of Iowa is closely associated with the chemical industries. Recent work has shown that the corn stalks and corn cobs are a raw material of great possibilities. Paper, furfural, charcoal, pyroligneous acid, oxalic acid and other materials have been prepared.

There are 150,000,000 tons of corn stalks in the United States and 20,000,000 tons of corn cobs. About a sixth of this yield comes from the state of Iowa. Experiments on a large scale recently have given great promise for the future utilization of these materials in various chemical plants.

Heavy Chemicals Shipped from Other Districts, Notably Chicago and St. Louis

Most of the heavy chemicals consumed in Iowa come from Chicago or St. Louis. There are two plants within the state producing lime, but a very considerable quantity of chemical lime comes from Chicago and from Hannibal, Mo.

Since the water of the state is very hard, averaging about 20 grains, a large and increasing amount of lime and soda ash is used annually for this purpose alone. Figures on the amount of heavy chemicals consumed in the state are not available from any source.

Transportation facilities of the state are splendid. Many of the transcontinental main lines travel the state from east to west and a series of railroads criss-cross the state from north to south. The roads are well laid out and paving is proceeding at a rapid rate. Truck transportation is developing. The state is bounded on the east by the Mississippi River, which is navigable and on the west by the Missouri River which could be made so. Efforts are being made to extend the barge lines from St. Louis up to Davenport, and this cheap river transportation will have a good effect upon the cost of raw materials in the state. Labor conditions in the state are good. Labor troubles are probably of less common occurrence than in most districts.

The power situation is well worked out and is under the control of competent and efficient engineers. Large power companies are developing control throughout the state, the plants are being located near the mines, and power can be had at a reasonable figure. The coal in the state is of good quality. There is some developed water power in the state.

Destructive Distillation of Corn Cobs and Utilization of Corn Stalk Fiber Promising

There is little doubt but that the state could support in the near future a sulphuric acid plant. Since there are splendid lime deposits in the state, this industry should be greatly enlarged. Destructive distillation plants could be established at strategic points for destructive distillation of corn cobs, which can be shown to be a much more economical proposition under present conditions than is wood.

The interesting thing about the corn cob is that the yield of acetic acid is much larger and the yield of methanol is much lower, as compared with wood. This would fit in nicely with the competition for synthetic methanol. The charcoal is of a splendid grade, although the pieces are small.

In the light of experiments that have been completed or are under way, the state could support large paper industries to make paper from corn stalks and likewise large factories for producing lumber substitute, such as insulating board.

Production of Compressed and Liquefied Gases in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, compressed and liquefied gases to the aggregate value of $56,404,723 were manufactured in the United States in 1925, this being an increase of 3.6 per cent as compared with $54,401,591 for 1923, the last preceding census year, and an increase of 40 per cent as compared with $40,420,835 for 1921.

The output in 1925 of the gases of chief importance with respect to value was as follows: Oxygen, 2,073,826 thousand cubic feet, valued at $22,577,110, a decrease in value of 3.4 per cent as compared with $23,382,236 for 1923; acetylene, 525,746 thousand cubic feet, valued at $13,514,964, an increase in value of 3.3 per cent as compared with $13,080,232 for 1923; anhydrous ammonia (not including production by gas companies), 31,724,858 pounds, valued at $6,771,876, an increase of 5.6 per cent in value as compared with $6,414,667 for 1923; carbon dioxide, 58,721,309 pounds, valued at $5,128,441, an increase of 2.7 per cent in value as compared with $4,992,373 for 1923; and chlorine, 104,960,186 pounds, valued at $4,236,307, an increase of 52.5 per cent in value as compared with $2,778,088 for 1923.

The table shows the products by kind, quantity, and value, for 1925 and 1923. The figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Production of Gases by Kind, Quantity and Value: 1925 and 1923

	Year	No. of Establishments	Unit of Measure	Quantity	Value
Total value	1925	..	....	....	$56,404,723
	1923	..	....	....	54,401,591
	1921	..	....	....	40,420,835
Acetylene	1925	69	M cu.ft.	525,746	13,514,964
	1923	58	M cu.ft.	522,349	13,080,232
Ammonia, anhydrous (a)	1925	16	Pound	31,724,858	6,771,876
	1923	12	Pound	23,529,382	6,414,667
Carbohydrogen gas	1925	12	M cu.ft.	77,463	805,139
	1923	12	M cu.ft.	70,234	735,988
Carbon dioxide (carbonic acid)	1925	44	Pound	58,721,309	5,128,441
	1923	45	Pound	51,095,965	4,992,373
Chlorine (liquid)	1925	14	Pound	104,960,186	4,236,307
	1923	12	Pound	76,118,240	2,778,088
Made and consumed	1925	..	Pound	61,365,457	....
	1923	..	Pound	49,242,780	....
Hydrogen	1925	48	M cu.ft.	150,502	876,976
	1923	51	M cu.ft.	103,818	695,476
Nitrous oxide (laughing gas)	1925	10	M gal.	54,882	729,534
	1923	12	M gal.	45,297	730,644
Oxygen	1925	141	M cu.ft.	2,073,826	22,577,110
Liquefaction process	....	..	....	1,693,460	....
Electrolytic process	....	..	....	380,366	....
Oxygen	1923	121	M cu.ft.	2,057,526	23,382,236
Liquefaction process	....	..	....	1,677,746	....
Electrolytic process	....	..	....	379,780	....
Sulphur dioxide	1925	6	Pound	8,968,453	638,175
	1923	4	Pound	6,576,000	414,049
Other gases (argon, nitrogen, ozone, sulphur trioxide, and gases not separately reported)	1925	..	....	....	1,126,201
	1923	..	....	....	1,177,838

(a) Not including production by gas companies.

ROCKY MOUNTAIN *Region*

Holds Undeveloped Resources of Vast Extent

By Stuart Croasdale
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MEN NOW LIVING and even some of those engaged in active business remember when the territory here surveyed—Wyoming, Colorado, New Mexico and Arizona—was considered a part of the "Great American Desert." The untraveled, uninformed, or casual observer may still take this viewpoint in terms of chemical industry because the Continental Divide of North America—the great Rocky Mountain system—traverses the central portion of these states from north to south and, aside from metal mines and raw materials, this section of the territory must be commercialized largely as scenery; and the climate is semi-arid which precludes intensive agriculture, hence the plains portion of the territory must be devoted principally to grazing, if utilized at all, and can never support a dense population. The simple mention of a few instances, however, will show the rapid strides that have been made during the life of the present generation to adjust and turn into commercial industry the existing natural conditions.

Less than a generation ago the suggestion of a sugar industry in this section was ridiculed by those living here, as well as those who were unfamiliar with the country, although it was known that both climate and soil were unusually favorable for the growth of sugar beets; the labor situation at that time was considered insuperable. Now, the Government estimates show that Colorado alone will produce 326,000 tons in 1926, or more than one-third of the 938,000 tons of beet sugar produced in the whole United States. Several related industries have developed from the manufacture of beet sugar, the principal one of which has made this section one of the largest stock feeding and fattening centers in the world by the utilization of the beet pulp.

Ten or fifteen years ago, corn was considered an impossible crop commercially; today the annual production in Colorado alone ranges from 10,000,000 to 22,500,000 bushels which is converted principally into pork and other animal products on the ground.

It may be claimed that these are not chemical industries but they may be classed as such, or at least are closely related to chemical industry. Many similar instances might be cited, but these will suffice to show what can be accomplished under apparently impossible conditions.

The total area of these four states is 438,351 square miles. The average altitude will probably approximate one mile above sea level. The average annual precipitation, compiled from the records of the United States Weather Bureau, is given below:

	No. of Recording Stations	Mean Annual Precipitation
Wyoming	96	14.66 inches
Colorado	190	17.06 "
New Mexico	178	15.50 "
Arizona	106	14.16 "
Total	570	15.63 "

This dry climate is a decided advantage in some industries, as for example, the manufacture of candy and chocolate products. In industries like wool-processing where humidity is required, a dry atmosphere can be conditioned to a more constant humidity than a moist atmosphere. The lack of precipitation conversely yields more sunshine. The amount of sunshine throughout this territory will approximate 360 days each year. Dry climate and sunshine have become recognized as essential for the most healthful living conditions, particularly for tubercular troubles, and they have also become recognized as conducive to greater human energy and efficiency. They have, therefore, a direct bearing on the labor phase of chemical industry as well as on the process of the industry itself.

The fundamentals necessary for the success of chemical industry are fuel, power, labor, transportation, and markets.

Labor—It has been stated that the best location for a silk mill is in a coal mining district where the miners' families insure an abundant supply of labor. The quantity and quality of labor in this district is ample to meet the demands of any industry. Wages compare favorably with any in the United States and the cost of living, according to the latest Government reports, is

almost exactly the mean of the entire United States. The sugar industry has to meet the most difficult labor conditions because, after the beets are harvested, the actual sugar-making campaign lasts only about 100 days; this brings an acute demand for labor for a short season but there has never been any difficulty in meeting it. As already stated, the climatic conditions are conducive to good health and permit many to become able-bodied citizens who could not live elsewhere; these conditions are also conducive to a high standard of living and to human efficiency.

Transportation—Seven great railroad systems enter Denver and furnish adequate transportation facilities to the entire western United States from the Mississippi River to the Pacific Coast, to the Gulf and Pacific Coast ports, and to connections beyond.

Fuel—The coal reserves within the boundaries of these four states are estimated by the United States Government as follows:

	Tons	Percentage Extracted
Wyoming	424,000,000,000	0.03
Colorado	371,770,000,000	0.06
New Mexico	163,780,000,000	0.03
Arizona	14,142,000,000	0.00
Total	973,692,000,000	0.04

The normal world's consumption for a number of years past has been 1,500 million tons of coal annually; there is, therefore, enough coal in these four states to supply the world for more than 600 years at the present rate of consumption and still allow for the waste in mining. The only state in the Union that exceeds Wyoming in estimated coal reserves is North Dakota with 500 billion tons, but this coal is a low-grade lignite.

The coal in this district exists in all grades from lignite to anthracite, including bituminous and coking coals. The only true anthracite outside of Pennsylvania is found in workable quantities in Colorado and can be delivered to any point from the Mississippi River to the Pacific Coast without fear of competition from the Pennsylvania anthracite.

Oil shale covers 900,000 acres in Colorado alone, with an estimated content of 57,000,000,000 barrels of oil, or nearly six times the total amount of petroleum that has been produced in the United States from the time of its discovery in 1859 to 1927. Wyoming has about 500,000 acres of oil shale land. Oil shale will eventually support a chemical industry of tremendous magnitude, not only in the oils themselves but in their derivatives. Petroleum and natural gas are produced in all the states except Arizona.

Power—The developed and potential water power in the four states, in blocks of 100 horsepower or more and available ninety per cent of the time, has been estimated by the United States Geological Survey as follows:

	Developed Horsepower	Potential Horsepower	% of Total in U. S.
Wyoming	7,886	704,000	2.02
Colorado	87,978	765,000	2.20
New Mexico	1,322	116,000	0.33
Arizona	38,760	2,759,000	7.92
Total	135,946	4,344,000	12.47

If provision is made for the storage of flood waters the potential horsepower can be greatly increased. Where coal can be supplied plentifully and cheaply to a power plant, it is generally conceded by power companies that steam-electric power can be produced as cheaply as hydro-electric power when the entire investment for water storage to maintain the maximum hydro-electric energy is taken into account. The Public Service Company of Colorado has recently completed its second unit of steam-electric power at the coal mines and now has available for market 65,000 horsepower They use pulverized lignite for fuel.

Production of Acids

Sulphuric Acid—This acid, which has been called the foundation of all chemical industry, has been manufactured in Denver since 1886. It was formerly made from low-grade pyritiferous ores obtained from the metal mining operations in Colorado. After roasting off the sulphur, the calcines were sold to local lead smelters for the recovery of the gold, silver, lead, and copper. The decline of the smelting industry in this immediate locality has rendered this practice unprofitable, and during the past few years the supply of raw material has been native sulphur from Texas.

At the present time this acid is used principally in oil refining, pickling of wire bars, manufacture of ammonium sulphate, and in the manufacture of mixed acids for explosives. Some years ago the large copper smelters in this and adjoining districts erected acid plants to mitigate the smoke nuisance, and to supply their acid requirements for the hydrometallurgy of copper and zinc ores and for the concentrating mills using the flotation process. The use of acid for these purposes has decreased materially during the last few years and now the acid-producing capacity in the Rocky Mountain section of the United States is far in excess of the demand for acid. Native sulphur and pyritiferous ores are available raw materials in this district.

Muriatic Acid—This is manufactured in Colorado and utilized principally in galvanizing processes, although some is used in the sugar industry and for other minor purposes.

Nitric Acid—This acid is also made in Colorado and is sold principally as a "mixed acid" with sulphuric acid for the manufacture of nitroglycerine for shooting oil wells.

Chemically Pure Acids—All of the above-named acids are refined in Colorado to supply the demand for pure chemicals for analytical purposes.

Chlorine—None is manufactured at the present time owing to the very limited demand. There are indications that it may be produced in the near future for hydrometallurgical purposes.

An attempt was made some years ago to market carbonic acid in cylinders for beverage purposes, refrigeration, and for some unknown use on the railroads, but it was not successful. A like attempt was made to market sulphurous acid but this was discontinued. In short, it may be said that there is acid-producing capacity already established in this district to meet any demand that may arise.

Alum and Aluminum Sulphate

Considerable quantities of these salts occur as a caliche in several localities within this district as a result of the weathering of alunitiferous rocks. An investigation of the value of this material some years ago led to the result that at St. Louis, the principal

market at that time, aluminum sulphate could be manufactured more cheaply from acid and bauxite than it could be produced from the natural salt and shipped to the market from the Rocky Mountain region—chiefly due to the distance of the natural deposits from a railroad. It is not known whether the marketing conditions have changed during recent years.

Alkaline Metal Salts

Salt—This raw material is now obtained from Kansas and Salt Lake; it is also available from the Salton Sink in southern California. Beds of salt from 200 to 400 ft. thick have been discovered in wells drilled for oil in southwestern Colorado, and other sources of supply are known within the district, but the demand has not been sufficient to prosecute their development in competition with the abundant supply from the above-named sources.

Sodium Sulphate—It is reported that this natural product is now shipped from Arizona at the rate of 200 to 300 tons per day. It is used principally in the manufacture of wood pulp and is especially adapted for the treatment of southern pine. Immense quantities of this salt exist in Wyoming and New Mexico in "dry" lakes, semi-liquid lakes, or flowing springs and are within easy reach of transcontinental railroad lines. These should form a profitable source of supply but, so far as known, nothing has been done to develop them.

Sodium Nitrate—A large deposit has been reported to exist near Glenrock, Wyoming, on which considerable money is now being expended for exploitation.

Sodium Carbonate, Bicarbonate, and Caustic Soda—About twenty years ago a plant was erected to utilize the natural sodium carbonate deposits near Green River, Wyoming. The alkali water was pumped from wells about 60 ft. deep and evaporated in pans. This yielded commercial carbonate of soda; caustic soda was also made. The salts made were of good quality and most of the products were sold on the Pacific Coast. After a period of operation the percentage of sodium carbonate in the water decreased and the percentage of other salts increased to such an extent that the industry became unprofitable and the plant was dismantled. Within this territory there is a satisfactory demand for caustic soda for oil refining, soap manufacture, and laundry work, to say nothing of additional uses that might be developed, provided some use for chlorine can be evolved. None is manufactured here at the present time.

Sodium Silicate—Considerable quantity of this salt was formerly used in the concentration of ores by the flotation process, but this demand has almost entirely ceased due to change in the methods. The principal uses now are in the preservation of eggs, as an adhesive in the manufacture of shipping boxes and cartons made from waste paper and strawboard, and in the manufacture of soap.

Sodium Fluoride—Some years ago an effort was made to manufacture this salt in Denver as a by-product in the manufacture of other salts, but the enterprise was never consummated. At that time, sodium fluoride was receiving a good deal of attention as a wood preservative. Both fluorspar and sodium salts can be obtained in quantity at satisfactory prices if a sufficient market exists for this commodity.

Potash—The Leucite Hills in Sweetwater County, Wyoming, are composed largely of a lava known as wyomingite. The principal constituents of this lava are the mineral leucite and free silica. These minerals exist in the correct proportions to form feldspar, but for some unknown reason they did not combine. The quantity of wyomingite in this particular locality is estimated at 2 billion tons by the United States Geological Survey, and it contains an average of over 10 per cent potash (K_2O). During the war period, considerable money was spent in the exploitation of this source of potash but no commercial process was developed. Since that time the cheap potash salts of Europe have again become available. This deposit is near a transcontinental railroad, coal mines, water, alunite, sodium sulphate, salt, and gypsum deposits; the conditions are all favorable for the production of potash and establishing a chemical industry, but the general opinion seems to be that the alumina and silica will have to be utilized also in order to yield a satisfactory profit. Alumina, of course, comes into a very restricted market and severe competition with cheap bauxite from Arkansas and South America. Nevertheless, the use of aluminum chloride for cracking petroleum, the use of aluminum sulphate for various purposes, and the use of alumina and silica for quick-setting cements are suggestive outlets, besides using the raw lava as a fertilizer either alone or with the phosphate rock that occurs in the same State.

In Colorado, near Colorado Springs, there are a number of millions of tons of tailings from the mills treating Cripple Creek gold ores, which contain about 7 per cent potash. These tailings are already mined and crushed to pass a 10 mesh screen. They are convenient to all the essentials for successful operation except a commercial process and a satisfactory market. Potash is reported to have been discovered in Hunters Lake in Weld County, Colorado, and to occur in commercial quantities. It has also been detected in the salt beds discovered in the oil wells in southwestern Colorado. During the war, the Great Western Sugar Co. erected a plant to recover potash from the molasses residues at their sugar refineries, but this was found to be unprofitable when the cheaper potash salts became available from Europe.

In southwestern New Mexico, the United States Government has withdrawn 7 million acres of public land supposed to contain potash. This land adjoins the great potash field of Texas, where thick beds of potash salts have been discovered by drilling.

Lithia—Near Dixon, Taos County, New Mexico, a large pegmatite dike has been found that contains commercial quantities of the lithium minerals, lepidolite and spodumene. This property is owned and operated by an eastern glass company which uses the lithia for toughtening the translucent glassware—lamp shades, cosmetic jars, and similar products which they manufacture. It is said to reduce the loss by breakage from 60 per cent to 3 per cent. It also reduces the viscosity when added to glass "batches," and when added in greater quantity it produces the opacifying effect. It has been discovered that lepidolite forms an excellent substitute for high grade fluorspar in the glass trade, in the manufacture of white table tops, and in the enameling industry. The ore is simply hand cobbed at the mine and the material shipped contains about 3 per cent lithia (Li_2O).

Ammonia—This is recovered from the by-product coke ovens of the Colorado Fuel & Iron Co. at Pueblo, and the production is about 750 tons of ammonium

sulphate per month. It is nearly all shipped to California, Hawaii, and the Orient for fertilizer. The Gordon-Keith process for the treatment of complex lead-zinc ores proposes to use "gas liquor" as a solvent for the zinc, but this process is not yet operating continuously on a commercial scale beyond the pilot plant. Gas liquor, obtained from the city gas works, contains about 14 per cent ammonia, of which about half is combined as a carbonate. An attempt was made sometime ago to market anhydrous ammonia for refrigeration purposes, but this was discontinued.

Alkaline Earth Salts

Limestone—Aside from its use in the manufacture of lime and for fluxing purposes in metallurgical operations, limestone is used locally in beet sugar refining for the recovery of additional sugar from molasses by the Steffen process.

Gypsum—Gypsum occurs in enormous quantities in all four states and is favorably located for utilization. At the present time it is utilized to the extent of the market for making building plasters, and blocks for interior partitions.

Calcium Phosphate—Large beds of this material occur in Wyoming, but the demand for fertilizer on western farms has not yet justified their exploitation.

Fluorspar—Fluorspar has been mined in Colorado since the early seventies. The state has not been a heavy producer and most of the production has been consumed in the local steel works. Most of the raw material has to be milled to remove the impurities, but shipments are now made regularly from both Colorado and New Mexico as far west as the Pacific Coast and as far east as Chicago. The production from the two states in 1925 amounted to nearly 15,000 tons.

Barites—Barite, of good grade, is known to exist in workable quantities in several localities within this district. It was used to some extent during the war for the manufacture of hydrogen peroxide. It is now mined and marketed to the sugar companies, where it will supplement limestone in sugar refining. Its principal use in this district might be for the manufacture of lithopone.

Arsenic

Arsenopyrite occurs in several localities but cannot be utilized profitably for the arsenic alone. White arsenic is produced as a by-product at most of the copper and lead smelters in the Rocky Mountain region and this can easily meet the demand of the entire country. Previous to the war, it was shipped even as far as Germany for glass making. The entire production is now absorbed in the United States. White arsenic is utilized locally for the manufacture of insecticides and for the manufacture of weed-killer used by the railroads.

Silicates and Clay Products

Asbestos—Chrysotile asbestos has been found in large quantities in two localities in Wyoming. The short fiber is suitable for making shingles and fireproofing material. With this mass of short fiber is found considerable spinning fiber, but the percentage that can be economically separated is not known. Considerable money was spent on the development of these properties some years ago, but they became involved in legal difficulties and have not been operated since. These difficulties have now been removed. The properties are favorably located for operation.

Feldspar—High-grade feldspar is mined from several localities in Colorado and shipped to Denver for grinding. One grinding plant has been in operation about a year and it is proposed to erect another plant early in 1927. This feldspar is very white and more easily fusible than most feldspars on the market, which makes it desirable for enameling. When ground to pass a 140-mesh screen, it brings the same price as the usual 200-mesh product. The market covers the western half of the United States and it can be readily sold in Japan. It is used principally for enameling and in the porcelain, pottery, bathtub, and tile industries, but its uses range from chicken-grit to silver polish. Contracts already exist for 1,500 tons of ground material per month and these could be expanded easily to 2,500 tons per month if the grinding capacity was available.

Clays—Clays of all grades are abundantly available for all purposes. A chemical porcelain plant was established at Golden, Colorado, during the war, to replace the porcelain formerly obtained from Germany. This industry has steadily grown until it now supplies the greater part of the United States with just as good chemical porcelain as was formerly obtained from abroad. Crucibles, muffles, and fire brick are manufactured here and shipped to all points where freight charges will permit. Kaolin exists in quantity and quality suitable for tableware but is not utilized. The interesting clay known as bentonite occurs in large quantities in Wyoming, but up to the present time its utilization has been limited.

Glass—Fifteen or twenty years ago a glass company prospered in Denver, manufacturing bottles and molded glassware. Then glass-blowing machines were perfected capable of turning out bottles in such enormous quantities that a couple of months' operation with an ordinary machine would supply this marketing territory for a year. The smaller glass industries were forced out of business or were consolidated into large organizations which monopolized the trade. These companies now supply the demand even though some food-product containers are shipped from as far east as Virginia. The raw materials, except soda, for making a good grade of bottles and molded glassware are here, and even the soda might be supplied from natural deposits, or manufactured, to meet this and other demands. A great deal of glassware is used throughout this territory, but it is doubtful if the quantity is sufficient to support the enterprise in competition with the large glass plants in the middle west.

Cement—Portland cement is manufactured within the district in sufficient quantity to meet all demands for this material at the present time.

Rare Metal Products

Molybdenum—There is now operated in Colorado the largest molybdenite property in the world. The ore reserves are estimated at 25,000,000 tons carrying less than 1 per cent molybdenite (MoS_2) per ton. The concentrating mill, using the selective flotation process, has a capacity of 800 tons of crude ore per day and turns out a high-grade product. Practically all of this product is used in ferro-alloys and in making high-grade steel for roller bearings. Molybdic acid is manufactured in Denver for the chemical trade, and for the production of metallic molybdenum used in radio appa-

ratus. Sodium molybdate is also manufactured, which is replacing sodium tungstate in the dye and ink industries. These salts are all sold in the vicinity of New York City.

Vanadium—Vanadic acid is manufactured on a large scale in Colorado by roasting a siliceous ore (roscoelite?) with common salt to form sodium vanadate. This salt is leached from the gangue and vanadic acid is precipitated from the aqueous solution by means of sulphuric acid. The vanadic acid is dried and shipped to the Atlantic Coast for the manufacture of ferroalloys. The deposit of ore is flat and is found over a large area of ground. The ore reserves will last a long time, although they have not been definitely defined. The crude ore contains about 3 per cent vanadium oxide (V_2O_5). C.P. vanadic acid is manufactured in Denver; also ammonium metavanadate for the ink and dye industries.

Radium—Carnotite ore from Colorado and Utah was formerly the principal source of radium for the world, and considerable radium salt was manufactured in Denver. The radium market is now overstocked from the richer ores from the Belgian-Congo in Africa. One firm in New Jersey continues to use Colorado carnotite in the manufacture of luminous paint.

Uranium—The only plant in the United States that is manufacturing uranium salts is located in Denver. Uranium nitrate is used in the moving picture industry for making colored films. Uranium acetate is also used. Sodium uranate, yellow and orange salts, are used in the ceramic industries and for making fluorescent glass. Uranium salts are also used in producing colors on terra cotta.

Materials for Pigments

Zinc Oxide—Both the high-grade zinc oxide and the zinc-lead pigment are manufactured in Colorado by roasting zinc sulphide ore in the usual manner, or by smelting complex zinc-lead ores in a reverberatory furnace and collecting the fumes. Both products go into the paint trade and some of the zinc oxide is used in Colorado and California in the manufacture of automobile tires and other rubber products.

Zinc Sulphate—This salt is now a by-product from lead smelting in Colorado, where the ore roasting is done by the Coolbaugh system. It is used locally to some extent in the concentration of ores by flotation, but its principal utilization should be in the manufacture of lithopone and in the production of electrolytic zinc.

Cadmium—Cadmium salts are produced, considerably in excess of the demand, as a by-product from lead-smelting operations. Before the war, these found their principal market in Germany. The metal is used for making alloys of low melting points, increasing the strength of copper wire, electroplating, and similar applications. The sulphide makes a very durable yellow pigment which is used by some railroad systems for painting cars. The use of this metal is increasing but so is the production.

Graphite—Amorphous graphite is mined intermittently in Colorado and its market up to the present time has been limited to the pigment trade.

Carbon Black—Unutilized natural gas is available in Wyoming for this industry.

Explosives—Two plants, one in Colorado and one in Arizona, are meeting all local demands. They are practically self-contained, manufacturing their own acids and other chemicals used in producing the finished explosive products.

Organic Products

Coal Distillates—The largest producer is the Colorado Fuel & Iron Co., which has the only by-product coke ovens in the district. This company divides the light oil distillate into benzol and xylol, or solvent naptha. No toluol is made. A great deal of the benzol is consumed by the rubber industries in Colorado and California, and the balance is shipped to the Atlantic Coast via the Gulf ports. It is understood that most of it is exported to Europe with gasoline as a motor fuel. Xylol also goes to the Atlantic Coast. The heavier oils and tars are all consumed at the plant as fuel for the open-hearth steel furnaces. These have been found to be more valuable for this purpose than as a source of coal tar derivatives.

At the Denver gas plant, which is the largest in the district, the light oils are not fractionated but are used as a solvent for the heavy tars and pitch in the manufacture of paint and roofing materials. The "carbolic oils" that are not used locally, are shipped to Texas, the Pacific Coast and to Honolulu. They are used in the manufacture of antiseptics, sheep-dip, and wood preservatives. Synthetic ammonia is now produced so cheaply that it has become unprofitable to recover the ammonia from the gas liquors.

Sugar By-products—The beet pulp is used raw as a stock food. It is also mixed with the molasses, dried, and sacked for shipment as a stock food. The molasses contains about 50 per cent of its weight in recoverable sugar. This is treated with lime according to the Steffen process, and about 60 per cent of the sugar is recovered. During the war, the residual molasses from the Steffen process was treated to recover the potash but this is no longer profitable; it is now mixed with the beet pulp as described above, or mixed with alfalfa meal and sold as stock food. This practice still continues to be the more profitable at some of the plants. A large quantity of molasses is shipped to Chicago for the manufacture of yeast. A plant has just been erected to recover more sugar from the molasses by the use of barium oxide. This treatment will follow and will treat the residual molasses from the Steffen process. It will recover about 20 per cent additional sugar from the molasses which, based on the original sugar content of the beet, leaves only 0.2 per cent unrecovered as refined granulated sugar. It has not yet been determined what will be done with the residual molasses from the barium process but it will probably be too low grade for anything but stock food.

Wool Products—About 75 per cent of the wool grown in the United States is produced in this district and in the neighboring states west. Two-thirds of the weight of raw wool is dirt and the natural oils. All of this wool is now shipped to Chicago and the Atlantic Coast (principally to Boston) to be scoured and woven into textile fabrics, and freight is paid on dirt and waste equal to twice the weight of the wool itself. While it is well known that all kinds of woolen fabrics have to be made in the same locality in order to utilize all the grades of wool, yet there seems to be no valid reason why the woolen industry and its by-products should not be moved West where the wool is grown, just as the cotton industry and its by-products has moved south where the cotton is grown.

Pacific NORTHWEST *Offers Markets and Raw Materials for New Industries*

By H. K. Benson

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DUE to similarity of natural resources, climatic conditions and transportation costs, the three states of the Pacific Northwest—Washington, Oregon and Idaho—comprise an independent industrial unit. If we add to these states the western half of Montana, we have an industrial block within which it is possible to distribute commodities cheaper than to obtain them from the Atlantic coast or the Middle West. Hence it is obvious that in this region, the industrial development will be largely dependent upon the use of available materials for distribution to its own population and for export outside of the district.

In the consumption of chemicals, two types of industries may be considered: (1) Those which have been established upon the abundance of cheap raw material and (2) those which serve the daily needs of the local population. In the first class may be included the industries dependent upon forests, mines and hydroelectric power.

The forest mantle of this region is enormous in extent, comprising fifty million acres of merchantable timber from which annually the cut now approximates twelve billion board feet of lumber. In the production of this lumber a million and a half cords of logging waste are left in the woods while two million cords of slabs ("mill waste") and two million tons of sawdust are produced at the sawmill. Furthermore this mantle is not disappearing, despite popular descriptions of forest fires and lumbering operations. Natural reforestation is a comparatively rapid process. It is said that spruce of size suitable for pulp wood and of the grade of Government spruce is already growing in the right-of-way of a railroad abandoned at the time of the Armistice. It is the opinion of those who have studied the problem that more lumber will be cut annually in a century from now than at present. Therefore, it is not exactly strange that under such an environment the pulp and paper industry should become established and undergo the rapid and substantial expansion which now characterizes this industry. A current trade journal (*Paper Mill*, vol. 49, No. 50, p. 10) lists the names of fourteen new pulp mills now in process of organization or construction in this region. The yearly production of pulp in seventeen mills is approximately as follows:

	Tons
Ground wood	275,000
Sulphite	200,000
Soda	12,000
Sulphate	25,000

The major portion of the chemical pulp is made into paper in twelve mills now in operation while others are in process of building. The consumption of chemicals in the pulp industry is of chief importance in this region, annually requiring in round quantities the following:

	Tons
Sulphur	22,000
Lime	25,000
Soda ash	2,000
Sodium sulphate	4,000
Bleaching powder	1,500
Rosin	500
Alum	600

Sulphur is obtained chiefly from the Gulf region although both Alaskan and Japanese sulphur have been used at times. Soda ash and bleaching powder are obtained principally from California although frequently stocks come from the Atlantic coast factories and, in the case of bleaching powder, from Kansas. Salt cake (sodium sulphate) has been chiefly imported from Germany, although recently shipments from California have been made. Rosin is obtained from the South.

The principal mining development in the Pacific Northwest (exclusive of Montana) has been in the production of gold, silver, copper and lead, valued at $21,500,000 annually. The value of coal mined annually is in excess of $15,000,000. Extensive deposits of low ash, high moisture sub-bituminous coal have scarcely been touched. Coking coals furnish the material for water, gas and metallurgical coke. Aside from flux and sulphuric acid, this industry does not consume chemicals.

The potential water power of the Pacific Northwest

is nearly one-half of that of the nation and is distributed as follows:

Distribution of Potential and Developed Water Power In Pacific Northwest

	Minimum Horsepower	Maximum Horsepower	Developed Horsepower
Montana	2,749,000	4,331,000	420,000
Idaho	2,362,000	5,067,000	243,000
Oregon	3,148,000	6,613,000	295,000
Washington	4,932,000	8,647,000	487,000
Total	13,191,000	24,658,000	1,445,000
United States	27,943,000	53,905,000	9,247,700

The fact that advantage may be taken of seasonal power has made it possible to sell surplus power to the chemical industry at rates as low as $10 per kilowatt year while continuous power may be obtained for $30 per kilowatt year. Certain types of chemical industry are fortunate in being able to take advantage of fluctuating loads, as for example in the arc process of nitrogen fixation where maximum efficiency is attained from the start of the process—i.e., there is little power loss in the starting and stopping of the process.

Two nitrogen-fixation plants producing nitrite of soda and anhydrous ammonia, respectively, are now in operation obtaining current at approximately the costs cited. These plants ordinarily make use of soda ash and sulphuric acid, both of which are obtained from California.

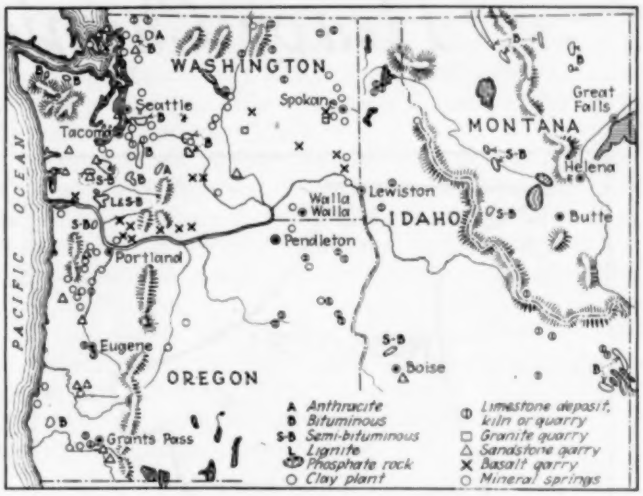
No definite figure can be obtained of the consumption of chemicals in industrial plants without conducting a special census for which time does not permit. Some idea of the volume can be obtained, however from the Census of Manufactures for 1923 for Oregon and Washington which gives the cost of materials in the following chemical-consuming industries:

Beverages	$1,514,362
Bread and bakery products	12,516,942
Chemicals	624,758
Confectionery	3,855,892
Dental goods	10,159
Fertilizers	377,785
Flavoring extracts	165,518
Paints	865,189
Soap	271,104
Wood preserving	3,451,268

To the above list should be added acetylene, cosmetics, disinfectants, dry cleaning, dye works, explosives, fireworks, inks, insecticides, insulation, laundries, meat packing, oil refining, rubber products, sprays, storage and dry batteries, tanning, vegetable oils, water glass, woolen mills and yeast.

Analysis of these industries show the use of the following chemicals: ammonia, ammonium nitrate, calcium carbide, caustic soda, chlorine, chrome and vegetable tannin, dinitrotoluol, glycerine, linseed oil, magnesium, naphthalene, potassium nitrate, sodium chlorate, sodium nitrate, sulphur, sulphuric acid, turpentine, varnish resins, all of which except ammonia are largely procured from distant points, several from foreign countries.

In the accompanying map is indicated the location of the principal mineral resources of this region which are of interest to the chemical industries. It will be seen that coal deposits are well distributed over the region. Limestone and clay deposits are also abundant. The phosphate deposits of Idaho and Montana are practically untouched. Extensive deposits of magnesite are worked in eastern Washington. Lumber waste is available for charcoal, tannin, alcohol and butyric acid. Extensive deposits of diatomaceous earth and of volcanic tufas are known. Arsenic is now produced and the manganese deposits in northwestern Washington are of con-



Principal Mineral Raw Materials for Chemical Industry in Pacific Northwest

siderable importance. For some years, deposits of practically chemically pure Epsom salts have been the source of most of the commercial product in this region. Saline lakes or deposits of sodium sulphate and sodium carbonate occur in central Washington and Oregon, but have not yet been utilized.

In addition to the raw materials of the region account must also be taken of those that come from other shores. From the Pacific Northwest three products are shipped in quantities of entire cargo lots and at least five other commodities often constitute the bulk of a ship's cargo. These are lumber, grain, flour, condensed milk, canned salmon, fruits, copper and paper. Because of the attractiveness of the outbound cargo to vessels which ply to foreign countries, increased attention is being paid by those countries to supply Pacific Coast ports with return cargo.

Promising Outlook for Chemical Industry

Mention has already been made of the remarkable expansion which the pulp and paper industry is undergoing at present. With the coming of kraft mills utilizing fir wood for its raw material at a cost of less than 50 per cent of that now commonly paid, it would seem absurd to import sulphate of soda from abroad as the local mills have been forced to do; especially absurd when deposits of practically pure Glauber's salts are nearby. The requirements of this industry for bleaching agents and the advantageous power rates would warrant the production of chlorine and its associate, caustic soda, for local use in it and kindred industries.

The fertilizer industry is a logical one for the Pacific Northwest. The fisheries industry of Alaska, Washington and Oregon has an annual output valued at $66,000,000. In 1924, fifty-four plants produced 25,000 tons of fish meal, 3,554,897 gal. of herring oil and 335,000 gal. of other fish oils. The nearness of the Idaho-Montana phosphates, with synthetic ammonia and cheap power at hand, assures some form of ammonium phosphate as a formidable competitor of the products now used as nitrogen and phosphorus carriers. Chemical industry will become established in this region. Already dotted with a score of pulp mills and as many more building and with factories engaged in the synthesis of nitrogen compounds, it is logical to expect that development into more diversified fields will occur as larger markets appear upon the horizon.

Heavy Chemical Industries of ST. LOUIS *District are Highly Developed*

By Charles W. Cuno
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A REVIEW of the production and consumption of chemicals in the St. Louis District (which includes southwestern Illinois and the eastern and southern portion of Missouri and Arkansas) leads to the generalization that there has been a steady and increasing demand over that of 1924 and 1925, somewhat higher prices and a firmness of market not equaled since the war period. The increase in prices is due partly to the advance in the price of sulphuric acid, and this in turn is due to the increase in the price of raw sulphur. In this general increase two exceptions should be noted; the decrease in price of ammonia due to the entrance of the synthetic product on this market and the decrease in price of phenol due to new methods of manufacture.

Fully two-thirds of the 6,000 manufacturing companies within the district are consumers in quantity of at least one chemical product, and in comparison, about 20 companies are engaged in the manufacture of chemicals. Some are merely refiners of heavy chemicals for further distribution, and others manufacture mainly for their own consumption. A large proportion of both heavy and refined chemicals is still being obtained from producers outside the district.

Within the district, five producers of sulphuric acid made in 1926 approximately 150,000 tons of 60 deg. Bé. acid and 27,000 tons of contact acid. This was consumed as follows:

	Tons		Tons
Fertilizer industries	53,000	60 deg.	....
Iron and steel	9,000	"	....
Metals refining	5,000	"	5,000 strong acid
Chemicals	46,000	"	5,000 "
Paints and pigments	24,000	"	5,000 "
Oil refining	10,000	"	12,000 "

Three plants produce together 7,000 tons of nitric acid, of which 3,000 tons is used by the manufacturers of explosives, 600 tons in chemical plants and the remainder by miscellaneous industries.

Muriatic acid to the extent of 16,000 tons of 18 deg. Bé. acid was produced in 1926 by two plants, 8,000 tons of which was consumed by the chemical industries, 2,400 tons by the glucose industries, 1,500 tons by the iron and steel industry and 2,100 by other manufacturing industries.

Of the 20,000 tons of chlorine manufactured in 1926 in the district, 10,000 tons was used in chemical manufacturing plants, 200 tons by water purification plants, 4,000 tons by metals refining plants, the remainder being used by the pulp and paper industries.

Caustic soda is produced in one plant to the extent of 24,000 tons, and about the same amount is shipped from outside the district. It is distributed as follows:

Chemical manufacture	30,000 tons
Soap and soap powders	15,000 "
Enamel and metals coating	500 "
Beverage companies	50 "
Electroplaters	250 "
Other industries	2,000 "

Salt cake is produced in two plants in quantity of about 20,000 tons, about 13,000 tons of which is purchased by glass works. The paper industry consumes about 5,000 tons and the rest goes to the paint and pigment manufacturers. Soda ash is not produced here but is shipped in to the extent of about 10,000 tons; railroads using 1,250 tons, dye and textile works 50 tons, alloy manufacturers 50 tons, the rest being distributed to the alumina, oil and metals refining plants.

Fourteen plants in the district produce 300,000 tons of lime, of which the chemical industries take 30,000 tons, agriculture and agricultural products, 50,000 tons, the rest being used by the building trades and others.

Twenty thousand tons of crude sulphur is consumed each year in acid manufacture, 2,000 tons in the manufacture of other chemicals and 1,000 tons of refined sulphur is distributed to various non-chemical industries.

Sixteen thousand tons of nitrate of soda is imported to the district, 15,000 tons going to the chemical industries, 250 tons to enameling plants, 200 tons to meat packers, 250 tons to metals refining and the rest to other industries.

Benzol is refined at one plant to the extent of 30,000 gal. a month. In addition 600,000 gallons is shipped in yearly, the bulk of which goes into the manufacture of intermediates.

Sodium silicate is manufactured by one plant and 20,000 tons is used by the paper box manufacturers, 5,000 tons being consumed by other manufacturers.

About 25,000 tons of white lead is produced in two plants about half of which goes to local paint manufacturers and the rest is shipped to other districts. These plants also produce litharge and red lead to the extent of about 14,000 tons, most of which is consumed by manufacturers of storage batteries.

Lithopone to the extent of 5,000 tons is produced in the district. The rubber industry uses about 200 tons. The rest is consumed by the paint industry. The same may be said of titanium oxide of which 2,500 tons is produced annually.

Zinc oxide is produced here to the amount of 27,000 tons, of which 1,000 tons is used in the rubber industry, 1,500 tons in paints, the rest being shipped to the paint and rubber industries in other districts. Of the 1,000 tons of barium carbonate manufactured in the district, 400 tons is used in the clay and enameling industries, the remainder in chemical industries and miscellaneous consumers.

Blanc fixe, 15,000 tons, is used mostly by the paint industry.

The blackings, stains and dressings manufacturers use 20,000 gal. of acetone yearly.

Boric acid and borax to the extent of 1,400 tons is distributed to alloy manufacturers, 50 tons; enameling companies, 600 tons; clay products, 20 tons; leather 30 tons; meat packers, washing compound and soap manufacturers use the rest.

Citric and tartaric acids are shipped in to the amount of 400 tons, of which 240 tons go to the beverage industries; 20 to the food canners; 20 tons to candy makers, the remainder being distributed among the drug and proprietary medicine manufacturers.

Oleic and stearic acids are distributed as follows: artificial stone, 50 tons; dyeing and textiles, 50 tons; rubber 100 tons; perfumery and toilet articles 250 tons; cleaning and polishing compounds, 250 tons; the remainder to food products and miscellaneous, making a total of 1,600 tons.

Trisodium phosphate comes in to the extent of about 2,000 tons and used principally in the soap powder industry.

Alum and aluminum sulphate is produced in the amount of 10,000 tons. Water softening plants take 5,000 tons, tanners 200, electroplaters 50, oil refineries 200, shoe and leather 300.

Sodium bicarbonate comes in to the extent of 3,000 tons. Fire extinguisher companies use about 100 tons; flour and produce companies, 500 tons; 1,500 tons goes to chemical industries and refiners and the grocery and drug trades absorb the rest.

Calcium chloride is distributed as follows: to refrigeration, 2,500 tons; the rest goes to oil refineries, disinfectant manufacturers and miscellaneous, making a total of 3,000 tons.

Copperas is recovered to some extent as a byproduct of metals pickling and is also brought in to the extent of 6,500 tons, of which 2,500 tons goes to pigment and rouge manufacturers; 3,500 tons to water purification plants and the remainder to diversified industries.

Epsom salts come in to the amount of 2,500 tons. Laundries and textiles use 550 tons; leather 250 tons; chemical industries and drugs absorbing the rest.

Glycerine is manufactured here to the amount of 11,000 tons. Extracts require 100 tons; confectionery 20 tons; tobacco 200 tons; drugs and toilet preparations 350 tons; beverages 50 tons, the remainder going to the manufacture of explosives.

About 300,000 gal. of grain alcohol is manufactured here and 3,700,000 gal. is brought in. Flavoring and extract companies use 100,000 gal.; blackings and stains, 200,000 gal.; drugs and toilet preparations, 400,000 gal., the chemical industry and automobile trade absorbing most of the rest.

A variety of fine chemicals, medicinal products and pharmaceuticals are manufactured here, one company alone listing 1,800 different products. Approximately one-third of the fine chemicals and medicinals used in the United States is distributed from this district.

In addition, a number of chemicals may be listed, the distribution of which is difficult to determine, such as benzoic acid, 20 tons; carbolic acid, 1,000 tons; cresylic acid, 250 tons; oxalic acid, 100 tons; aqua ammonia, 800 tons (most of which goes to the chemical industry), ammonia anhydrous, 400 tons (mostly to refrigerating plants); chloride of lime, 500 tons; blue vitriol 400 tons; carbon bisulphide, 120 tons; carbon tetrachloride, 350 tons; chloroform, 50 tons; formaldehyde, 200 tons; sodium thiosulphate, 600 tons; magnesium carbonate, 100 tons; petrolatums, 800 tons; caustic potash, 400 tons; potassium nitrate, 400 tons; rosin, mostly used in soaps and varnishes, 2,400 tons; sodium bichromate, 1,000 tons (250 tons of which is used in the leather industry and about 600 tons in the chemical industry); sodium cyanide, 80 tons, a large part of which is used for case hardening; sodium fluoride, 400 tons, a large percentage of which is used in making insecticides and moth exterminators; sodium nitrite 60 tons; sulphur dioxide, 150 tons; and tin oxide 50 tons.

Principal Producers of Chemicals in District

The principal chemical manufacturing companies in this district are:

Mallinckrodt Chemical Works, established in 1867; manufacturers of fine chemicals and medicinal products.

National Lead Co., 1870; manufacturers of lead products and paint pigments.

The Eagle-Picher Lead Co., 1870; manufacturers of heavy chemicals, lead products and paint pigments.

Monsanto Chemical Works, 1900; manufacturers of heavy chemicals, synthetic intermediates, synthetic flavors and essentials.

American Zinc and Lead Co., manufacturers of zinc oxides and chemicals.

Southern Acid & Sulphur Co., manufacturers of acids and heavy chemicals.

General Chemical Co., 1890; manufacturers of heavy chemicals.

Warner Jenkinson and Co., 1900; manufacturers of dyes and fine chemicals.

Provident Chemical Works, manufacturers of phosphates and other chemicals.

Certain-teed Products Corp., 1910; manufacturers of chemicals pigments, solvents, etc.

Geo. S. Mepham and Co., 1900; manufacturers of iron oxide and earth pigments.

National Pigments Co., 1890; manufacturers of pigments and allied chemicals.

Chemical and Pigments Co., 1920; manufacturers of lithopone and allied products.

Alton Barium Products Co., 1920; manufacturers of barium carbonate, blanc fixe, etc.

Titanium Pigments Co., 1924; manufacturers of titanium pigments and allied products.

Philadelphia Quartz Co., 1924; manufacturers of sodium silicate and allied products.

In addition, the Atlas Power Co. and the E. I. du Pont de Nemours & Co. have plants in the district, manufacturing chemicals and explosives.

Five petroleum companies refine 100,000 bbl. of petroleum per day with an average yield of about 35 per cent gasoline and the corresponding quantities of fuel oil, lubricating oils, petrolatum and paraffin.

Fourteen lime companies produce lime and lime products.

St. Louis District Possesses the Essentials of Economic Plant Location

The raw materials that are likely to attract chemical industries to this district are lead, zinc, barium, bauxite, coal, coal tar, petroleum products, iron and clay. St. Louis is ideally situated as a distributing center, being close to the center of population, on a waterway soon to be developed for heavy shipping and with ample railroad connections. Indeed, one chemical plant in East St. Louis claims direct connection with twenty-two railroads. The labor market is ample and stable. St. Louis is contiguous to the largest and cheapest coal market in the world. Electric power can be purchased as low as 1.2c. per kw.-hr. and for non-peak loads for about half that price. Even in private plants the cost of generation can be reduced to less than 0.9c.

What chemical industries should be developed in this district to supply present and future needs is a difficult question to answer. A glance at the list of industries mentioned above will show that a number have been started since the War and are making good in a splendid way, but an equal number of companies have attempted to start industries in various chemical products and have failed. One of the raw materials lacking in this district is salt. It would be folly to bring salt here, fabricate it into allied products and attempt to sell them in districts contingent to Michigan or some other district where salt is a raw material. Nevertheless, it would be logical to manufacture salt products here for local consumption. In lead and zinc products St. Louis producers apparently control the market and you frequently see the quotation "F.O.B. St. Louis." On the other hand, barium products are apparently controlled by foreign producers.

Heavy and Fine Chemical Industries Are Strongly Intrenched

It is apparent that our lead, zinc, barium, aluminum, and clay products industries are already highly developed and that we are producing fine chemicals and medicinal products for nation-wide consumption. Our coal-tar products, intermediates, essentials and organic products are rapidly developing, and our pig iron production which was nothing five years ago, is now 200,000 tons. A new furnace, now ready to be fired, should double that for next year. It seems, therefore, that producers are particularly alive as to the possibilities of the St. Louis district as a market and as a distributing center, and that for that reason, any proposition to establish new industries in this district should be canvassed with a great deal of care.

Production of Inorganic and Organic Acids in 1925

THE Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, acids to the aggregate value of $83,233,023 were manufactured in the United States in 1925, representing increases of 1.5 per cent and 38 per cent respectively as compared with $82,027,-389 for 1923, and $60,262,890 for 1921.

The principal acids in 1925 named in order of value ($1,000,000 or more) are as follows: Sulphuric, oleic, carbonic, acetic, mixed (sulphuric-nitric), hydrochloric (muriatic), nitric, citric, stearic, tartaric, phosphoric, and boric (boracic).

The statistics for 1925 and 1923 are summarized in the following statement. The figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Production of Acids by Kind, Quantity and Value: 1925 and 1923

	Year	Number of Establishments	Unit of Measure	For Sale Quantity	For Sale Value	Made and Consumed, Quantity
Total value...	1925	..	....	....	$82,612,598	....
	1923	..	....	....	82,027,389	....
	1921	..	....	....	60,262,890	....
Acetic..........	1925	13	pound	....	4,013,995	....
Dilute.......	1925	..	Pound	35,452,776	1,342,218	5,019,198
Glacial and anhydride..	1925	..	Pound	25,037 220	2,671 777	....
Acetic..........	1923	16	....	....	4,154,838	....
Dilute.......	1923	..	Pound	28,032,384	876,864	1,437,661
Glacial and anhydride..	1923	..	Pound	29,619,745	3,277,974	3,043,455
Arsenic and arsenious (crude and refined)...	1925	10	Pound	22,877,000	781,328	7,776,000
	1923	10	Pound	29,393,747	2,607,829	3,621,360
Benzoic *a*.......	1925	6	Pound	122,247	74,412	80,109
Boric (boracic)..	1925	4	Pound	15,604,654	1,202,382	....
	1923	3	Pound	17,277,801	1,736,081	....
Carbonic (carbon dioxide)..	1925	44	Pound	58,721,309	5,128,441	....
	1923	45	Pound	51,095,965	4,992,373	....
C'tric..........	1925	6	Pound	7,598,213	3,469,740	72,317
	1923	6	Pound	5,689,473	2,829,306	....
Hydrochloric (muriatic)....	1925	37	Ton	152,587	2,941,175	72,782
20 deg. Bé...	1925	..	Ton	128,533	2,448,203	70,228
18 deg. Bé...	1925	..	Ton	22,808	322,299	2,554
Other........	1925	..	Ton	1,246	170,673	....
Hydrochloric (muriatic)....	1923	39	Ton	155,814	3,102,172	62,707
Hydrocyanic *a*..	1925	7	Pound	2,288,598	881,101	....
Hydrofluoric....	1925	7	Pound	5,589,221	504,511	1,572,462
	1923	7	Pound	4,267,459	413,821	600,922
Mixed(sulphuric-nitric).	1925	39	Ton	61,290	3,766,696	99,087
	1923	51	Ton	77,933	5,502,735	78,534
Nitric *b*........	1925	53	Ton	26,852	3,559,695	92,800
	1923	55	Ton	21,759	2,741,370	91,357
Oleic (red oil)...	1925	14	Pound	64,983,440	6,090,802	....
	1923	15	Pound	48,786,009	4,353,654	....
Phosphoric.....	1925	7	Pound	21,330,215	1,488,701	8,241,707
	1923	11	Pound	12,829,361	955,194	5,000,362
Stearic.........	1925	8	Pound	18,027,131	2,364,179	416,898
	1923	13	Pound	22,477,754	2,752,995	472,328
Sulphuric (50 deg. cent Bé)......	1925	178	Ton	4,697,116	38,330,274	2,315,212
	1923	185	Ton	4,344,698	38,274,540	2,210,819
Sulphuric, reclaimed (50 deg. Bé).....	1925	70	Ton	174,232	1,456,097	501,816
	1923	64	Ton	170,138	1,478,558	418,530
Sulphurous (sulphur dioxide).	1925	6	Pound	.8,916,053	636,079	....
	1923	4	Pound	6,576,000	414,049	....
Tannic.........	1925	6	Pound	1,439,957	585,951	....
	1923	5	Pound	969,541	357,023	....
Tartaric........	1925	4	Pound	5,498,920	1,541,955	....
	1923	4	Pound	5,868,000	1,544,431	....
Other acids *c*....	1925	..	....	....	3,795,084	....
	1923	..	....	....	3,816,420	....

a Data for 1923 included with "Other acids."

b Total production, basis 100 per cent, 79,880 tons for 1925 and 77 633 tons for 1923

c Principal acids for 1925, with respect to value, were as follows: Phenol (carbolic), salicylic, oxalic, vanadic, and lactic.

EDITORIAL REVIEWS OF THE

Progress of Technology in 1926

Petroleum Technology Contributes to Conservation

CONSERVATION is now the order of the day in the petroleum industry and it is to the technologist that the industry has turned for the solution of this major problem. The influence of technology, particularly in the refining branch of the industry, can be definitely measured in terms of conservation. The cracking process, for example, has progressively increased the yield of gasoline from crude oil. This figure has mounted from 30.9 per cent in 1923 to 33.1 per cent in 1924, to 36 per cent in 1925 and possibly to 40 per cent in 1926. This increased recovery has been accomplished without sacrifice of quality; in fact with the growing demand for premium motor fuels of anti-knock characteristics, there has actually been a distinct improvement in quality. It is reliably reported that 6 per cent of the gasoline used in the United States in 1926 was of the anti-knock type, having been obtained from selected crude oils, by cracking processes, by blending with benzol or by the addition of the tetraethyl lead compound.

Research on the industry's oldest refining process—distillation—has lately resulted in a further improvement in gasoline yield and quality. The chief petroleum engineer of the Bureau of Mines estimates that the development of efficient fractionating equipment has added the equivalent of 6 to 8 per cent to our crude oil supply. Developments such as the greater recovery of gasoline from refinery gases, the production of isopropyl and higher alcohols from cracking-still gases and the improved utilization of fuel in the refinery have been practical conservation measures that have substantially benefitted the industry.

As the manufacturers of steel and the newer materials of construction have come to a better understanding of the problems of the industry, there have been improvements in equipment which have greatly extended its service to the refiner. Furthermore the petroleum technologist is constantly bringing to his industry and successfully applying equipment developed in other of the chemical engineering industries. One example, from many that might be adduced, is seen in the recent introduction of thickeners and classifiers in a process for removing suspended carbon from heavy cracked distillate and cracking-still residuum in order to produce marketable Diesel and burner oils.

Another trend that became apparent during 1926 is in the direction of improved lubricants. Development and further adoption of such production processes as contact filtration has been one stimulus. Scientific research on lubricating oils and their behavior in the crankcase of the motor has been another. Finally, from the marketing standpoint, the anti-knock gasolines have demonstrated that the motorist is willing to pay a premium for unusual performance. Better motor oils, designed scientifically to meet the motorist's requirements, seem likely to find a market even at a considerable premium over the usual product.

But a review of petroleum technology during 1926 would not be complete without reference to the 5-year program of scientific research in the geology, physics and chemistry of petroleum that has been inaugurated by the American Petroleum Institute and supported by a half-million dollar fund made available through separate grants by John D. Rockefeller and the Universal Oil Products Co. Thirty-one projects in research have been considered, seventeen have had the approval of the Institute and work on these was started during 1926 in various university and industrial laboratories. This far-seeing program augurs well for the future of the industry for it paves the way for further accomplishments in the practical conservation of our petroleum resources.

Coal Byproducts Industry Makes Steady Progress

PROGRESS in the coal products industry during 1926 has been more a matter of consolidating a position than going forward to new lines. The various innovations of recent years in the gas and coke fields have been more widely adopted and operating technique has been carried toward perfection. In low temperature carbonization, the past year has seen further definite steps toward the establishment of several of the more promising processes on a commercial basis. The manufacture of synthetic chemicals from coal has progressed to some extent and much interest is manifested in this branch of industry.

The two most marked tendencies in the gas industry are toward the substitution of bituminous coal for all other fuels in the water gas generator and the further building of small coke oven plants for the supply of city gas. The additional year's experience with the Pier process and the "back-run" and Chrisman cycles has perfected the operating technique for water gas generators using bituminous coal to the point where the generator capacity is now as high as with coke. Automatic charging and automatic, continuous clinkering devices are now available which promise to make the operation of water gas sets automatic and, except for the intermittency caused by blasting, continuous.

Many small cities are already completely supplied with gas made in byproduct coke ovens. Large cities are tending to supply their base load from this source, the

existing water gas and coal gas plants serving to meet peak loads and as standbys. Even in the city of New York, which is extensively supplied with coal and water gas plants, the Consolidated Gas Co. is building a large byproduct coke plant. It seems certain that the byproduct oven will, in the not distant future, supply most of the manufactured gas load of the country.

Commercial units of the Greene-Laucks process, being built by the Old Ben Coal Corporation at Franklin, Ill., and of the McEwen-Runge process, installed at the Lakeside plant of the Milwaukee Electric Railway & Light Co., by the Combustion Engineering Corporation, were commenced during 1926. Although commercial-sized plants of two other low temperature processes have been built in the past, neither was successful. These new ventures and the Consolidated Coal Products Company's successful McIntire process plant at Fairmont, W. Va., hold some promise of proving whether low temperature carbonization of coal will be an economic and commercial possibility in the United States.

The production of synthetic ammonia from gases distilled from coal increased during the past year, development following lines already established. The manufacture of synthetic alcohols and liquid fuels from coal has not yet been established here although European developments in this field have been followed with attention and much experimental work is under way.

Without doubt, the outstanding event of the year was the International Conference on Bituminous Coal conducted by Carnegie Institute of Technology in November and already reported at length in *Chem. & Met.* This conference brought together representatives of all industries in any way interested in coal processing. The resulting community of interest, now definitely established, should do much to help these industries to work out a utilization of the world's coal resources that will insure the conservation of this essential chemical raw material.

Economic Factors Curtail Fertilizer Developments

ALTHOUGH the fertilizer industry entered 1926 optimistically expecting 10 to 15 per cent increase in sales, this was not realized because of factors whose influence could not be foreseen until early in the year. These were a general tightening of credit, collapse of the Florida land boom and the beginning of cotton price recessions which made southern financial interests timid about granting fertilizer credits to the farmer. As a result the sales of fertilizer in 1926 were approximately the same as in the preceding year and the industry closed the delivery season at the end of May with large stocks of fertilizer and fertilizer constituents on hand.

The full effect of over-production in cotton and the continued agricultural depression has not yet been felt by the fertilizer industry. It is expected, therefore, that there will be still smaller total deliveries of fertilizer in 1927, the reduction being variously estimated from 5 to 25 per cent. It is probable that about 10 per cent smaller tonnages of fertilizer can be marketed in 1927 than in 1926.

As a consequence of economic conditions there have been no technologic advances. The principal technologic effect has been the closing down of less efficient plants, and there is evidence that this influence will go further during the coming year. The result will be an increase in average plant efficiency, but this does not represent a real technologic advance.

The German fertilizer industry, dominated by the I. G., apparently is adopting the American practice of marketing complete fertilizer and there is evidence that the European farmer is being encouraged and trained in the use of such products. It is unlikely that this tendency to make complete goods abroad will result in imports into the United States from such sources in large quantities in the near future, but there is an immediate threat of more intensive competition with American exports of mixed goods in all other parts of the world.

Phosphate rock developments in Northern Africa and the use of high purity rock from the South Pacific Islands have been larger during the past year, with a consequent curtailment of foreign markets for American prosphate rock.

The pressure of world over-production of industrial and agricultural nitrogen has forced down prices of ammonium sulphate to low levels. The trend to agricultural use of ammonia nitrogen is also encouraged by the constantly increasing evidence that substitution can be made without decrease in plant food value, even under many circumstances previously thought to require nitrate nitrogen.

Supplies of potash from domestic sources continue to be limited to the production of Searles Lake. Exploration in Texas and New Mexico of natural potash deposits is actively under way, with governmental backing as well as active industrial participation. It seems to be demonstrated that deposits are available in those areas that can be developed by sound technical methods, but the commercial prospects cannot yet be well gaged.

Synthetic Nitrogen Dominated in 1926

CONSIDERATION of figures given elsewhere in this issue reveals that the production of nitrogen compounds by synthetic processes now dominates the world situation and that nitrogen in Chilean nitrate is a poor third, being preceded by nitrogen from byproduct sources. Of synthetic processes direct synthetic-ammonia methods account for two-thirds of the world capacity now built or building and for three-fourths of the prevailing production rate. Practically all of the plants u.e, in a sense, the modified Haber process but because of varied details and also of national pride in their development they are usually designated by a variety of names. The most important distinctions are, however, the operating pressure and the system for purifying or recirculating the nitrogen-hydrogen mixture. In the United States at the end of 1926 there was one Casale, one Claude, one General Chemical, two "American" (F.N.R.L.), and three other modified-Haber plants.

The plant of Lazote, Inc., near Charleston, W. Va., began operating early in 1926 using the Claude system with practically every detail as used in Europe. Bituminous coal was the fuel for the water-gas generator at the outset, but great difficulty developed through accumulation of hydrocarbons in the fractionating column where the hydrogen is separated from the other water-gas constituents. As a result it was necessary to change to coke as a generator fuel; and still further

modifications are contemplated, especially in methods of producing hydrogen which will be better adapted to American conditions.

At the end of the year about 60 per cent of the synthetic ammonia output of the United States was being made from water-gas hydrogen; the remainder was made in about equal amounts from byproduct hydrogen and from electrolytic hydrogen made specially for this purpose. Plans thus far announced for 1927 indicate that water-gas hydrogen will probably supply nearly half of the synthetic ammonia, that byproduct hydrogen will give 40 to 45 per cent, and that electrolytic hydrogen will be used for only 10 per cent of the output of 21,000 to 25,000 tons which is estimated for this year.

The outstanding feature of the year in the byproduct industry was the almost complete disappearance of the market for ammonia liquor. This has forced gas works to dispose of ammonia either as sulphate or to someone who will convert it into sulphate before marketing. As a result plans are being formulated for co-operative sulphate plants, so arranged that a number of small gas works can ship their liquor to a central point for conversion. New small types of sulphate equipment have also been developed in order to fit the byproduct units to gas works of small capacity.

As Chilean nitrate production has dropped nearly 20 per cent there has been almost no building of new nitrate capacity by old producers. The Guggenheim interests have, however, completed and begun to operate on a large scale, their new plant at Coya Norte. As members of the Chilean Nitrate Producers Association this company has asked for an allotment under the association rules of 600,000 metric tons per year, which is approximately 30 per cent of the 1926 rate of production for the whole industry, showing clearly what an important factor this new plant will be in production in Chile, whether or not it is granted as great an allotment as is requested.

Ammonia Oxidation, Another Threat to Chilean Nitrate

IN THE United States the replacement of sodium nitrate by synthetic and byproduct ammonia has been confined largely to agriculture. In Europe, however, the substitution of ammonia oxidation for the conventional saltpeter-sulphuric acid process of nitric-acid manufacture is already an accomplished fact in several of the larger chemical plants. Lately significant progress has been made in this country in applying the newer process to the production of nitric acid and of nitrogen oxides for chamber-process sulphuric-acid plants. It is reliably reported that the largest user of nitric acid in the United States contemplates making his future nitric-acid supply largely, if not wholly, by the oxidation of ammonia.

The technology of ammonia oxidation has advanced to the point where this is entirely feasible and the spread between ammonia and nitrate prices adds an economic stimulus to the movement. It appears, therefore, that Chilean nitrate may be superseded to a large extent in the field of nitric-acid and nitrogen-oxide production. With this additional threat to the Chilean nitrate business, it is becoming more apparent that the synthetic processes will in time dominate the nitrate-nitrogen situation, as they have already dominated the ammonia-nitrogen situation throughout the world.

Chromium Alloys as Engineering Materials

VERY few if any materials of construction have created such widespread interest during 1926 as have the chromium alloys. Although not possessed of universal chemical resistance, the chromium irons and steels in particular, have a combination of properties that have won for them recognition in a variety of chemical engineering industries.

Chromium alloys are not new, as has been noted by White and Clark of the University of Michigan, Department of Engineering Research. As early as 1820 Faraday and Stoddard prepared a chromium steel; this however did not result in any immediate commercial application. Nothing further was recorded until 1872, when Woods and Clarke investigated a series of alloys containing from 4.5 to 32.0 per cent of chromium and from 0.6 to 0.7 per cent of carbon. Patent applications on this series of corrosion-resisting alloys were denied. This investigation was followed in 1900 by the small-scale production of chromium steel by Jacob Holtzer and Co. These steels contained 0.4 per cent of carbon and from 1 to 15 per cent of chromium. It remained, however, for Ellwood Haynes and Harry Brearley, working independently, to promote the commercial use of chromium steels. In Haynes' work of 1913, later patented, the carbon limits are 0.1 to 1.0 per cent and the chromium limits are from 8 to 60 per cent. The Brearley patents include carbon up to 0.7 per cent and chromium from 9 to 16 per cent. Other significant patents are those of Cox, who specifies carbon from 1.0 to 1.5 per cent and chromium from 20 to 60 per cent; Patch and Furness, who specify carbon from 1 to 2 per cent and chromium from 15 to 20 per cent; and Becket, who specifies carbon from 1.5 to 3.0 per cent and chromium from 25 to 30 per cent.

What are the properties that commend chromium alloys to the engineer? These depend upon the composition of the alloy, as has been pointed out by MacQuigg and others. Up to 5.0 per cent of chromium, high strength, ductility and hardness are obtained, especially in the presence of at least one other element, as for example, nickel. From 14 to 16 per cent of chromium added to cast iron imparts resistance to oxidation. From 12 to 16 per cent of chromium, carefully controlling the carbon, the alloys have resistance to oxidizing corrosive mediums and have excellent physical properties. Chromium alloys containing from 10 to 20 per cent of chromium and with considerable nickel, have marked resistance to oxidation and possess high tensile strength at elevated temperatures. Beyond 20 per cent of chromium, the steels have in addition to oxidation resistance, marked resistance to nitric acid and nitrates. The hardness is also a characteristic property. In general then, the significant properties of chromium alloys are: (1) Oxidation resistance at high temperatures, (2) resistance to oxidizing solutions and (3) high tensile strength at elevated temperatures.

But the recent popularity of the chromium alloys is not accounted for solely by these desirable properties. Once a material ten times as costly as ordinary steel, it is now economically permissible as a material for large-scale equipment. Furthermore, the working characteristics are good, and fabrication by welding is being developed rapidly to a satisfactory stage. Thus the chromium alloys, long known but never fully appreciated, are at last becoming available for plant construction.

Chemical Engineering Serves the Pacific Coast

IN NO part of the country is the importance of chemical engineering technology as an aid to industrial development more apparent than on the Pacific Coast. Industries making use of this technology are growing rapidly and new lines of application are being constantly opened. Being relatively young, the industrial establishments of the West are for the most part quicker to seize and use new methods than are those in other, older, sections of the country. This is partly because they are able to profit by the experience of older plants, and partly because the western manufacturer is keen to learn and to try new things and is quite willing to spend money in the development of new ideas on a factory scale.

A list of the chemical products of the Pacific Coast runs the gamut from agar to xanthate, being stronger in inorganic chemical production than in organic, however. Several of the products are specialties not made elsewhere in the world. Of first importance is petroleum and its complementary fuel, natural gas, since they form not only the raw materials for many plants but constitute the fuels for others. The recovery of gasoline from natural gas and the subsequent piping of the residual gas to industrial centers has developed a technology of great interest. In one system, the gas is piped through a 12-in. welded line a distance of over 110 miles. It enters the line at high pressure being delivered to the local distributing system at about 20 lb. A single compressor plant at the intake furnishes the means of transportation. Large supplies of natural gas have localized the glass industry in California and the cement plants are beginning to find it an ideal fuel. New developments in the high-pressure storage of gas have materially aided in its distribution.

In districts farther removed from natural gas supplies, domestic gas is being made from oil. Looking to the future, when the cost of oil may be prohibitive, the gas companies are preparing to change to other methods of production, the first change having been made this past year with the altering of the Maryville, California, plant from oil to water gas.

The removal of hydrogen sulphide and the recovery of the sulphur in its elemental and useful form without the formation of noxious odors in the vicinity of the plant, is one of the outstanding developments in the gas industry.

Production of calcined magnesite is localized in the United States to this section. New developments in the burning of the rock have been successfully applied in Washington near Spokane, while minor improvements have been developed in the California plants to increase the production of this commodity. The increasing use of "Sorel" cement and stucco on the Pacific Coast has necessitated larger production of magnesium compounds. The production of the chloride from salt bitterns is rapidly growing. With this has begun the manufacture of other byproducts such as bromine, the first plant recently having been put in operation.

Salines are of importance in California and the development of the process for the manufacture of borax and potash from the Searles Lake brines, has become, with the present increase in capacity of the plant, one of the classics of chemical engineering. Further developments along similar lines have taken place with the production of various alkali products from other desert lakes. At Owens Lake the manufacture of soda ash has been stabilized and a plant for the production of caustic soda using natural deposits of sodium sesquicarbonate has just begun operation.

Progress in the utilization of saw-mill wood waste for the production of cedar oil, turpentine and tan bark has resulted in several new plants.

One of the outstanding creditable accomplishments is the technology of the manufacture of agar, now produced at San Diego, California. A product superior in every way to foreign agar is manufactured by carefully controlled chemical engineering operations.

Industrial Electrochemistry Made Striking Progress in 1926

IN INDUSTRIAL electrochemistry, the most striking achievement during 1926 was the commercialization of the process for the electrodeposition of latex, or rubber. In October the American Anode, Inc., was formed, combining the two European interests and the American interests, the latter represented by the Eastman Kodak Co. and The B. F. Goodrich Rubber Co. The anode serves as a mold or form upon which the rubber is deposited. One licensee is making insulated copper wire, superior in quality to the older product. The application of the process is unlimited.

In nitrogen fixation, the Air Reduction Co. has placed on the market a new cyanide product, a complex calcium cyanide, supplied as a brown powder which when brought into reaction with water produces hydrocyanic acid gas, a most valuable disinfectant and used in combatting the scale pest of the citrus fruit trees.

In electrolytic refining, the commercialization of the production of seamless nickel tubes from pure electrolytic nickel is worthy of note. These tubes have important applications, particularly in chemical engineering, due to the metal's resistance to corrosion.

The electrometallurgical developments at Kellogg, Idaho, have attracted world-wide attention. Galena is roasted and leached with a brine solution and the spongy lead is deposited on a rotating cathode. There has been a revival of interest in the re-establishment of a tin smelting and refining industry on this continent.

In electroplating, the outstanding event is the general adoption of chromium plate as a hard and corrosion-resistant coating for automobile parts, plumbing fittings, marine fittings, high-temperature iron and steel apparatus, etc. Direct tests have shown that chromium-plated steel is more resistant to atmospheric corrosion than steel coated with any other metal.

Among the cells, the photo-electric alkali metal cell has to a large measure displaced the classic selenium cell. The potassium cell is extremely sensitive and responds instantly. The tantalum rectifier cell has to a large extent outstripped its older competitor, the aluminum rectifier, and is competing strongly with other types of apparatus for the conversion of alternating to direct current.

A new electrolytic industry has sprung up. Processes have been developed for the electrolytic production of mineral colors, such as the oxides of iron. The pigments produced are of very fine texture and the shades can be controlled to a nicety by regulating current density, temperature, and concentration of the electrolyte. Cheap raw materials are used in the process.

CHEMICAL EXECUTIVES SEE

Sound Basis for Industry in 1927

High levels maintained during 1926 should continue as business sets itself for a stable course in both production and consumption of chemicals.

Mineral-Acids Industry Faces Future With Confidence

By Philip M. Dinkins

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CONDITIONS in the mineral-acid industry during 1926 were generally satisfactory to both producer and consumer. The consumer was able to obtain his supply of acids at low prices compared to other commodities, and the volume of consumption was such as to permit most manufacturers to operate their plants at a comfortable percentage of full capacity. Production and consumption of all mineral acids have been increasing steadily during the last few years. The 1926 tonnage showed a satisfactory normal increase over the previous year and this normal rate of increase is expected to continue.

The general expansion of business during 1926 was accompanied by a similar expansion in the consumption of the mineral acids, which play an important part in so many branches of our industry. This is not unusual, as any increase in general business is bound to be accompanied by a greater demand for the principal heavy acids. In addition to this usual increase, however, there were other additions to the sum total of mineral acids used in this country. New industries and new plants have sprung up which use these acids, principally sulphuric acid but also muriatic and nitric acids. These new industries have not made it necessary for manufacturers, as a whole, to add to their plant capacities but have permitted them to operate at a level more nearly approaching full production. This wider distribution of the mineral acids will undoubtedly increase as the prosperity and consumptive capacity of the country continue to expand.

By all means the outstanding feature of the mineral-acid industry today is the price situation. Sulphuric acid is unique in being one of the few basic commodities still selling below pre-war prices. Everyone who has any contact with the heavy chemical industry, knows that sulphur is the foundation stone of the entire industry. Sulphuric acid is made directly from sulphur, and most other chemicals are made either from, or with the aid of, sulphuric acid. Consequently any change in the price of sulphur is sure to have a far-reaching effect upon the chemical industry as a whole. This change in the price of sulphur came during 1926, and it was a revision upward of several dollars per ton. There has been therefore a substantial advance in the market price of sulphuric acid. There have also been corresponding advances in the prices of muriatic acid and nitric acid. These advances will undoubtedly affect the prices of all chemicals. They are, however, no more than necessary to take care of the increased cost of sulphur, so that the acid manufacturer is no better off than he was before.

Where this increase in the cost of sulphur will stop is hard to determine. Some who are closely in touch with the situation predict still further advances which will bring the price several dollars per ton higher than it is now. There is a point, however, where this advance will stop. This point is determined by the cost of pyrites, together with the cost of operating with pyrites, and the cost of conversion of the present sulphur burners to pyrites burners. This point has apparently not been reached as yet but the possibility of the replacement of sulphur by pyrites will serve somewhat as a check upon excessively high sulphur prices.

The manufacturers of mineral acids look forward confidently to the future with the expectation of a steady growth in the industry and a regular and increasing demand for their products. The price structure is not entirely satisfactory at present but with the increasing cost of the raw material, correspondingly higher and prices will undoubtedly be obtained and should at some time yield a more satisfactory return to the producers. The mineral-acid industry, as a whole, is probably better off at the present time than it has been at any time since the war and is looking forward to still better conditions to come. This basically important industry has been through a trying period without, in any way, curtailing the extremely necessary service which it renders to industry as a whole. It is hoped that the expectations of better times held by the leaders in this industry will be amply justified by the developments of the future.

Sulphur Output Increased To Meet Consuming Demand

By Raymond F. Bacon

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FINAL figures for the production and sales of sulphur during 1926 will not be available until March. However, from the present estimates it appears that for the first time in three years the producers of sulphur mined sufficient quantity to balance or nearly balance sales. The cessation of operations at Sulphur Mine, Louisiana, made it necessary in the years 1924 and 1925 to deplete accumulated stocks by nearly 750,000 tons, or about 25 per cent. The two producers of sulphur in this country seem now to have so adjusted their operating schedules that we may expect with some confidence that the present stocks of about 2,000,000 tons will not be further diminished.

These two companies, using the Frasch or hot-water method of mining sulphur, produce over 99 per cent of the sulphur mined in this country, which in turn has supplied over 80 per cent of the world's requirements since 1918. The shipments for 1925 were slightly in excess of this, amounting to 1,850,000 tons out of the 2,250,000 tons consumed throughout the world. The largest individual consumer is the United States, which in 1925 used about 1,200,000 tons, a figure probably a little smaller than final statistics for 1926 will show. The indicated production by the American companies for 1926 is approximately 1,850,000 tons as compared with about 1,400,000 tons in 1925.

Sicily in 1925 produced only 208,000 metric tons, and was compelled to withdraw about 47,000 tons from surface stocks to fill the total Sicilian shipments of 255,000 tons. In 1926, according to the best estimates, the same tonnage was produced, with expected shipments between 260,000 and 270,000 metric tons, causing a further depletion of stocks. The result of these withdrawals has been to reduce their stocks to between 50,000 and 60,000 tons, the lowest figure in the recent history of the Sicilian sulphur industry. Just what steps are being taken to remedy this situation, and how far their result depends on the development of the plans attributed to Mussolini for the electrification of the mines, cannot be estimated at this moment. The outcome of this development will be awaited with interest.

Of the two other producing countries little definite information is available. Chile, it is presumed, maintained its normal annual production of about 5,000 to 10,000 tons, and Japan between 35,000 and 45,000 tons. In the latter case, production just balances consumption, this being more particularly true since the price has reached the high level of about 80 yen per ton.

Prices Up to Pre-War Level

The advance of about $4 per ton in the price of sulphur during the past year has brought it up to about the pre-war level, a price still relatively lower than most commodities. The increase has been reflected in greater profits for the producers in the United States, and from recent press reports, has had the effect of bringing about the opening of one of the larger deposits of the mountainous region in the West.

Extensive prospecting operations are being carried on in the Gulf Coast region, and while they can hardly be expected to discover as remarkable deposits as those at Gulf and Sulphur Mine, it is probable that good commercial deposits may be found.

The demand for sulphur gives every indication of continuing, so that the requirements during the first half of 1927 should be equal to those of the same period in 1926. The operating capacity of the plants in this country is such that they can satisfactorily meet these demands, and with increased efficiency made possible by high production, should maintain their present favorable position even were 1927 to show a slight decrease in shipments.

Pyrite, it is believed, although exact data are not available for 1926, maintained in this country about the same production rate as in 1925. The monthly reports on pyrite imported into the United States, however, indicate an increase of about 100,000 tons over the 276,000 tons brought in during 1925. This increase appears to be the result of greater business activity in all lines, rather than a replacement of crude sulphur in any of the plants that have been operating on that material.

Alkali Industry Closes Record Year With Good Prospects For 1927

By Fred G. Lancaster

Sales Manager, Diamond Alkali Co., Pittsburgh, Pa.

DISTRIBUTION of the basic alkalis, soda ash and caustic soda, follows the trend of general business and directs attention to the many primary industries in which they are utilized. This distribution presents a composite picture of the activities of the glass industry, soap, paper, textile, oil, water treating, chemical and other business of the country. A chart of alkali shipments over a number of years has heretofore shown a peak of distribution in March for the first half of the year, and in October for the last half of the year, with a pronounced drop in the curves during July and August, and between October and March. During 1926 these curves have been reduced and distribution has been maintained on a more even basis as compared to previous years. This does not mean that there has been any change other than the development which has taken place in all basic industries. The production of alkali is flexible and readily follows the composite curve of manufacturing activity in general.

The production of soda ash for the year will probably average close to 75 per cent of normal plant capacity, and while actual figures are not available it is believed that shipments of soda ash this year have exceeded any year since the World War, and the distribution of caustic soda will closely approximate, if not exceed, in tonnage the largest previous year.

The splendid condition of the railroads and their unprecedented transportation facilities have developed a close alliance between production and use, so that there is scarcely a month between the manufacture and utilization of basic raw materials. The facilities for manufacturing soda ash and caustic soda have been consistently increased and improved, and are ample to take care of the needs of the country and to warrant the sensible and praiseworthy efforts that producers in the United States are making to develop and maintain our logical export markets.

Industrial activity subsides as the holiday season approaches, and last year industry experienced an era of such broad distribution that the holiday recession was more noticeable than usual.

We look forward to 1927 with the belief that the favorable factors in our industry considerably outweigh any unfavorable influences which might develop. We approach the end of the year with no stocks in consumers' hands, and only the usual "safety margin" accumulations at makers' works. We do not anticipate a trade boom during the coming year, but believe that volume will continue to be reasonably satisfactory with narrower margins for profit. From a manufacturing standpoint, the coal situation which is expected to develop in the Spring, provides a hazard of major importance. On the theory that it is better to be cheerful, we approach that period with the conviction that, as the hills always flatten out as you reach them, American ingenuity will find a sensible solution for those problems,

The factors then that influence the production and distribution of soda ash and caustic soda are not unlike the conditions that affect and govern industry in general. The favorable factors are evident in the promise of sustained production, high wages, abundant credit, railroad prosperity, and lower taxes. The unfavorable tendencies will be due to declining commodity prices, lower production, building recession, and lower wage scales. The balance seems to favor a constructive interpretation of these tendencies, and the belief that, while 1927 may not equal the volume of the present year, it will nevertheless be a year of normal business prosperity.

American Potash Industry to Expand Greatly in 1927

By John E. Teeple

Consulting Chemical Engineer, New York City

THE AMERICAN potash industry is much the same at the end of 1926 as it has been for the last couple of years. The total American production has been probably 8 per cent of the total American consumption. Of the American production the American Potash & Chemical Corporation, as usual, has probably made over 85 per cent, and the rest has come from various by-product plants.

The year 1927 will see a marked change in this respect. The American Potash & Chemical Corporation has been largely increasing its plant so that its production alone for 1927 should be well over 50,000 tons of K_2O, which should be in the neighborhood of 20 per cent of American consumption. This will make the Trona plant one of the three or four largest potash plants in the world, besides being by long odds the largest borax plant in the world. Presumably the production of by-product potash in the United States will be less than 5,000 tons, as it has been for two or three years.

Fertilizer companies and other buyers of potash manifest the same spirit of co-operation that they have for several years. They arrange to take all of the American product offered before making purchases abroad. America should use a good deal more potash than she does, and it is not likely therefore that this increase in American production will have any marked effect on imports.

Wood Chemical Industry Turns the Corner

By M. H. Haertel

National Wood Chemical Association, Orange, N. J.

TO OBTAIN a proper perspective of the hardwood-distillation industry during 1926 it must be borne in mind that the distillation process results in three primary products: methanol, acetate of lime, and charcoal. Each of these products goes into a distinct field of distribution, and their respective marketing conditions bear no relation one to the other, excepting the fact that of course the quantities produced rise and fall in approximately the same ratio.

The opening of 1926 found methanol selling at a price that was far below the production cost, as determined in the painstaking and efficient investigation made by the experts of the United States Tariff Commission. This discouraging state of affairs continued till well into the second quarter, when economic correctives made themselves felt. Existing stocks of wood were being rapidly depleted, while very little cutting was being done. The result was obvious. As the supply of methanol decreased, the price rose, the turn coming at about the middle of the year. The following tank car prices were reported in December, 1926; 95 per cent, 80 cents; 97 per cent, 82 cents; pure, 85 cents; denaturing grade, 80 cents; methyl acetone, 85 cents in tank carlots. Demand at the end of the year was good, with firm prices.

Acetate of Lime Holds Steady

Acetate of lime showed remarkable steadiness, production and shipments virtually balancing each other. Government figures show that stocks increased from about 9,000 tons in January to a high point of 12,560 tons in May. From that time on there was a steady decrease, until the accumulation at the end of the year was about the same as at the beginning. The price reflected this statistical position faithfully. The year opened at $3.25 per cwt. This price held steadily until the latter part of the year, when the decrease in supply was reflected by an advance of 25 cents early in November; the trade journals quoted a price of $3.50 in December.

This Marked a Return Toward the Higher Price Levels of 1923 and 1924

Charcoal, being used so widely as a domestic fuel, is a seasonal article, reaching its low point during the summer, and increasing during the winter months. Prices fluctuate to such a degree that it is difficult to determine an accurate market price at any one time. This article is used only to a small extent in the chemical industries, so price figures, even if they could be supplied, would be of little interest. Suffice it to say that there is practically no stock on hand in the warehouses of the manufacturers.

In general, the year was satisfactory, not because of actual financial returns during the period, but because it seems to mark the turning of the corner. It cannot be denied that the outlook seemed gloomy in 1925. However the position, both as to consumption and stocks on hand, showed a steady improvement. There is good reason to assume that the present favorable position will continue for some time.

Volatile Solvents Showed Increased Use in 1926

By B. R. Tunison

Vice-President, American Solvents & Chemical Corporation, New York City

The YEAR just ended was similar to 1925 at least to the extent that the unusual became the usual order of the day in the volatile solvent industries. Moreover, the satisfactory expansion of general business, and chemical manufacturing in particular, was reflected almost without exception in these industries.

Outstanding from the point of view of increase in volume of production are those solvents used in the manufacture of nitro-cellulose lacquers. Apparently the further development of lacquers of the so-called "brush" type so that they may be used for general household purposes as well as for the finishing of automobiles has been remarkably successful. Higher boiling solvents such as butyl alcohol and butyl acetate experienced a marked increased in production. It is probable that the production of butyl alcohol, acetone and butyl acetate was about 50 per cent greater in 1926 than in 1925. The production of amyl acetate has not kept pace with that of butyl acetate largely because of the limited production of fusel oil.

As indicated by the statistics of the accompanying table, the production of ethyl acetate did not show an increase in 1925. In that year its use in lacquers was undoubtedly greater than in previous years, but a smaller quantity was used in the manufacture of artificial leather. The production in 1926, however, was probably greater than in any year in the history of the industry.

Action by the Government in increasing the duty on imported methanol undoubtedly stimulated greater production on the part of the domestic producers.

Furthermore the Bureau of Internal Revenue issued a regulation requiring an additional quantity of methanol to be added to the most important formula for completely denatured alcohol beginning January 1, 1927, and production of methanol was increased in anticipation of this increased demand. During the first ten months of 1926, the production was 7,770,491 gallons as compared to 5,838,000 for the same period of 1925.

The output of acetone was also increased during the year since it is the joint product obtained with butyl alcohol in the fermentation of cornstarch.

Alcohol Industry Faced Unusual Conditions

The denatured alcohol industry was subject to unusual conditions during 1926. There was a large carry-over of both alcohol and molasses. In addition the large molasses crop helped to demoralize the markets during the first part of the year. Because of these conditions buying normally done in June and July was transacted in April and May. Production in April, May and June was above the same period in 1925 while that in July, August and September, was much below 1925. It is expected that the total production in the calendar year 1926 will be below that of 1925. Although the Treasury Department report for the fiscal year ended June 30, 1926, showed an increase from 81,805,273 gal. in 1925 to 105,375,886 gal. in 1926. It must be kept in mind, however, that the total denatured alcohol production cannot be taken as an industrial index because of the fact that nearly half of all of the alcohol produced is used in the anti-freeze solutions for automotive equipment. This largest single use, and a real determining factor of the alcohol industry, is dependent almost wholly on weather conditions. The large carry-over of alcohol into 1926 was due to the unseasonable and mild weather of the latter part of 1925.

It is believed that the industrial use of alcohol in 1926 will show a satisfactory increase in keeping with that of other chemical industries, even though the production data may be confused by the inclusion of anti-freeze alcohol.

The solvent industries during 1926 have had a reasonable share of the general progress experienced by the chemical industries as a whole.

Progress in The Production of Solvents, 1921-1926

	1921	1922	1923	1924	1925
Denatured alcohol, gal.**	22,388,825	33,345,748	57,565,143	67,687,296	81,808,273
Methanol, gal.* (crude)	....	6,808,911	8,593,727	6,897,589	7,651,125
Acetone, lb.	4,380,100	....	8,742,805	....	....
Carbon tetrachloride, lb.	....	11,166,318	13,513,644	14,275,057	16,163,104
Chloroform, lb.	944,303	....	1,805,083	1,301,492	1,305,868
Ether, lb.	3,763,300	4,017,043	5,104,157	5,314,928	5,355,050
Ethyl acetate, lb.	5,310,688	16,114,458	25 887 720	27,222,761	26,678,737
Amyl acetate, lb.	636,000	1,692,074	3,207,022	1,514,123	1,338,456
Butyl acetate, lb.	....	2,467,506	1,816,086	7,095,662	16,472,914
		Estimated	Over	Approx.	
Butyl alcohol, lb.	2,000,000	4,000,000	4,613,396	14,250,062	....
Amyl alcohol, lb.	112,384	....	1,130,000	....	154,990
Isopropyl alcohol, lb.	....	256,868	....	....	....

* For 10 months of 1926 the Dept. of Commerce reports an output of 7,770,491 gal. of refined methanol.

** For the fiscal year ending June 30, 1926, the output was 105,375,886 gal.

Lead Pigments Show Little Gain During 1926

By O. C. Harn

National Lead Co., New York City

The total production of lead oxides in 1926 seems to have made little if any gain over 1925, some of the industries which are large users of these products showing a gain and others compensating losses.

The protection of property with paint got away to a bad start the first half of the year, showing serious decreases in the use of paint. This was due mostly to bad weather in the spring and early summer, but in the months which followed, the sale of both white-lead and red-lead increased very rapidly, and along with other paint products, made a satisfactory showing by the close of the year. This was also indicated by the increase in the use of paint oils.

There was little fluctuation of prices on white-lead and oxides during the year. Dry white-lead was quoted during most of the year at 10$\frac{3}{4}$c. per lb. In November a recession of $\frac{1}{2}$c. was made, and another drop of $\frac{1}{2}$c. in December, following declines in pig lead. White-lead-in-oil, used by painters, had a similar drop in sympathy with the rest of the market, from $12.35 per hundred pounds in carload lots, at which price it remained steady during the year, to $11.74 in the middle of December. Basic lead sulphate was quoted at 10c. during most of the year but in the closing months decreased by degrees to 9c. where it stands. The prices of oxides fluctuated the latter part of the year, becoming steady from the first of November, at 11$\frac{1}{4}$c. for dry red-lead and 10$\frac{3}{4}$c. for litharge. Lead acetate prices were practically steady, there being but one change, a decrease of $\frac{1}{2}$c. in the spring. The sales of that commodity showed very little change over 1925.

Insecticide Industry Completes Best Year Since 1923

By George B. Heckel
Secretary, Agricultural Insecticide and Fungicide Manufacturers' Association, Philadelphia, Pa.

IN THE special annual census of the agricultural insecticide and fungicide industry, conducted by the Bureau of the Census for the year ended June 30, 1925, 19 companies representing about 70 per cent of the total production reported as follows:

	Production, Pounds	Stocks on Hand June 30, 1925, Pounds
Calcium Arsenate	19,911,262	15,558,214
Lead Arsenate Powder	13,523,902	2,153,553
Paste	341,580	36,193
Paris Green	3,544,887	2,640,809

The corresponding report for the year ending June 30, 1926, which has just been released, shows the following:

	Production, Pounds	Stocks on Hand June 30, 1926, Pounds
Calcium Arsenate	5,363,320	6,172,446
Lead Arsenate Powder	16,573,784	1,981,133
Paste	324,430	13,400
Paris Green	2,863,391	1,164,297

While June 30 is not the logical end of the consumption year, and steps are being taken to have further returns made as of September 30, nevertheless the two periods are comparable, and show that the industry is improving its statistical situation rapidly and satisfactorily. The year ending September 30 was, in this respect, probably the most satisfactory of the past four years.

Prior to two years ago, when the Agricultural Insecticide and Fungicide Manufacturers' Association was formed the industry had no means nor motive for the kind of co-operation which has become a vital necessity in modern American business, and even now is reluctant to co-operate to the full extent desirable. But the demonstration is proceeding and it is confidently expected that all in the industry will eventually recognize the importance and necessity of this work.

Since its formation the Association has succeeded in greatly simplifying and reducing the number of packages used; has, in conjunction with the Bureau of Explosives and the Interstate Commerce Commission permanently averted an embargo on the most important of the industry's products; has standardized the effective composition of one important product; has secured the help of the Bureau of the Census in the periodical collection and distribution of statistics, and has in many ways promoted more ethical and improved practices.

It is felt by the leaders of the industry that they have been faced by under consumption rather than over production. The control of insect and fungus pests is essential to the maintenance of our population. It directly affects the returns to farmers and horticulturists, and the cost of food to the nation.

With these facts before it, the Association has undertaken a campaign of education for the American people, the results of which cannot but be beneficial to all concerned.

New pests appear and spread rapidly from time to time, as witness in recent years, the Japanese beetle, the San José scale and the Mexican corn borer. Each must be studied, circumscribed and circumvented. Economic application of insecticides on a large scale is essential. This is in course of satisfactory solution by the growing use of the air-plane in the treatment of cotton fields, forests, orchards and mosquito breeding waters. There will always be a great need for insecticides and fungicides, and in spite of the unsatisfactory condition of the past few years the future is full of promise, if manufacturers will learn the modern lesson of co-operation for the common welfare.

Good Outlook for Zinc Pigments In Consuming Industries

By C. F. Beatty
New Jersey Zinc Co., New York City

BUSINESS conditions in the zinc oxide and lithopone industries depend chiefly on conditions in the paint, rubber and linoleum fields since these are the greatest consumers of zinc pigments. Consequently, the sale of zinc pigments in 1927 will be chiefly influenced by conditions in the paint, rubber and linoleum fields.

Whatever happens in other lines, the paint business in 1927 should fully equal that of 1926, due in no small measure to the cooperation of members of the paint industry in taking their story to the public through the "Save the Surface" and "Clean Up and Paint Up" campaigns. The industry is in a particularly healthy state and while weather conditions have a good deal to do with the ultimate sale of paint products, new fields have opened up for industrial and interior finishes which have done much and will do more for those engaged in their manufacture.

Pyroxylin lacquers in which zinc oxide and lithopone find application are developing at a rapid rate and during the first half of 1926, as compared with the second half of 1925, showed an increase of almost 63 per cent in production.

The use of leadless exterior paints is increasing and will increase as there is scarcely a paint manufacturer in the country today who is not making a zinc oxide-lithopone outside house paint both for the professional painter's use and in ready-mixed form for "shelf goods."

Rubber and Linoleum Prospects Good

The rubber industry is, of course, very closely allied to the automotive field in which the situation for 1927 is far from clear. However, cars of whatever age or mileage must have tires, and tires will be sold irrespective of who sells them.

One of the largest tire companies is reported to have planned an addition to its productive capacity for small tires involving the expenditure of half a million dollars. Another of the larger companies is planning to build four new warehouses to release space for production heretofore used for storage. This involves an expenditure of three-quarters of a million dollars. Another tire company is planning to spend a like amount to increase its capacity 50 per cent. Plans for increased production are also announced by two other tire producers of good size. This would indicate confidence on the part of tire manufacturers that 1927 will be a good

year, at least from a production standpoint, and that means a good year for zinc pigments in the rubber field.

In the linoleum industry we have to consider both the printed and inlaid types of floor covering. It is a little early yet to gage the printed linoleum business for 1927, as at present it appears that some consumers in the classifications hitherto assigned to printed linoleum have been improving their economic position at such a rapid rate that inlaid floor coverings, the more expensive type, are replacing the older and cheaper type of goods.

However, zinc and lithopone are used in both types of linoleum and with the increase in consumption of inlaid, where zinc oxide and lithopone are used in the light colors, the outlook is good. Bookings by jobbers for inlaid linoleum have already reached the point where manufacturers have cause for gratification.

With the level of trade and industry continuing high, with the absence of new high records and alarming peaks, and with only moderate changes in conditions affecting industry as a whole, the zinc pigments should continue to be in as fully a favorable position as in 1926.

Synthetic Ammonia Industry Still Has Its Growing Pains

By Robert J. Quinn

Assistant Director of Sales, The Mathieson Alkali Works, New York City

NINETEEN TWENTY-SIX was a very unsatisfactory year for the manufacturers of aqua and anhydrous ammonia. To be sure, markets were active and a fair volume of tonnage developed, but competition was of such a nature that there were only small profits to some producers and large losses to others to compensate for the energy expended.

The highly competitive merchandising situation that became so acute in the fall of 1925, developed with increasing intensity during 1926 and finally in November and December, reached the point where it was actually destructive.

It is only natural that there should be some radical readjustments in any industry's transition through a period which is so essentially and basically economic as is the one in which the American ammonia industry is now struggling. These readjustments are proceeding in a business-like way and as soon as the industry, in a broad sense, becomes convinced that the change is inevitable, business can again be placed upon a sound basis; but the high prices of the past, are gone for good.

From the standpoint of international economics, it is vital that, for mercantile and military independence, the American industry keep pace with those of other leading nations in the development of nitrogen fixation. One of the outstanding lessons from the World War was the realization that the synthesis of ammonia was destined to become a world influence of enormous power.

It is logical and inevitable that an American synthetic ammonia industry should be developed. It is also logical and consistent with the preservation of natural resources. But excessive capacity has been installed resulting in serious disturbances in the marketing of ammonia products. This condition was brought about to a great extent by the fact that as new production came onto the market, the older producers refused to relinquish any important volume of business and as the new production was in many cases chargeable to experimental development or had to be liquidated, price became the controlling factor.

Progress has been made in the production and distribution phases of the industry. Because of the intensity of competition, every reasonable economy is being observed and each producer is apparently operating on the theory that it is necessary to produce at full plant capacity in order that cost of production may be reduced to a minimum. Distribution expense has always been high, but when the profits were large, this was justified. Now, however, the cost of distribution is completely out of proportion with the value of the commodity and important economies have been and will be effected. From the selling point of view, little progress has been made. The most primitive methods are in use and selling expenses are high. In most cases, the selling and distributing costs exceed the actual manufacturing cost.

Seven synthetic ammonia plants were in operation during 1926. Another one was completed and is standing by waiting a favorable opportunity to start operations. Several others are under consideration or actually being planned. The industry has expanded rapidly, but there is no inducement for attracting into the field those who have no supply of hydrogen to utilize, or those who have no well established business to protect.

There have already been some important changes in the personnel of the industry. Some of the newcomers may not weather the storm; some of the older companies may line up with the new or even pass out of the picture completely. There will undoubtedly be some important changes during 1927, and eventually a strong and stable industry will be built around the survivors.

Ammonia Oxidation Among New Outlets

New uses and outlets for ammonia are being developed and promise some relief to the conditions caused by present over-production. Ammonia oxidation in connection with the sulphuric and nitric-acid industries is being actively promoted and offers a large outlet with steady all-year demand. The development of those rayon processes which use ammonia is another outlet of probable increasing importance. The refrigeration industry, which is now almost completely converted to a synthetic basis, is an extremely seasonable outlet, so that new uses in the chemical industry which consume ammonia all year 'round, are being actively investigated. It appears quite probable that those industries which require supplies of highly purified ammonia, will utilize the synthetic material, while the byproduct material from coke and gas plants will move into sulphate for the fertilizer trade. Anhydrous ammonia is now being shipped in considerable volume in tank cars of 30,000 to 50,000 pounds capacity. This will undoubtedly result in its wider application by reduction of cost of freight on container equipment.

The ammonia business cannot follow its present trend much longer without the appearance of casualties. Each of the principal factors feels that he is being attacked and that while his own activities may appear to be aggressively offensive, they are intended as defensive measures. The entire situation while deplorable and enormously expensive, is probably like the backwoods surgeon's diagnosis of a tough lumber jack, who was suffering from a bad infection of a leg—"A very bad case and I believe we should cut the leg off—right back of the ear."

Coal Tar Products Affected by British Strike

By W. E. Jordan
Manufacturer's Representative, Brooklyn, N. Y.

COAL-TAR crudes in 1926 were, on the whole, in a satisfactory position as far as the United States is concerned, although quite the reverse was true in Great Britain. There the coal strike caused a cessation in the industry for several months and adversely affected production to the extent of about two-thirds, thus crippling the export end of the business. In the United States we have had a good output of all the products made from coal and little surplus remains.

Of the various grades of benzol—C.P., 90 per cent and motor—all have been absorbed in the consuming industries, particularly in paint and varnish and rubber manufacture. Motor benzol is becoming in greater demand almost daily, both here and abroad, for it is a most economical motor fuel either when used straight or when mixed in the proper proportion with high grade gasoline. This enables the large distillers of benzol to balance their output of light distillates when the purer grades of benzol or of toluol and xylol are not needed.

Toluol, xylol and solvent naphtha, have been in increasing demand within the past few years by the lacquer industry but this year requirements have been cared for without any shortage such as occurred a year ago.

Creosote oil, especially that to meet the A.R.E.A. or the A.W.P.A. specifications, continues in demand with insufficient domestic supplies to care for the requirements. Nor does it appear that we shall be able to meet this demand from our present sources. About 50,000,000 gal. was imported in 1926.

Supplies of tar-acid oils or dip oil, used by disinfectant makers, were ample partly because of the lack of demand from that trade, which in turn was attributable to the unfavorable position of the farmers and stock raisers throughout the country.

Cresylic acid and cresols were in a peculiar position during 1926. Outside of that supplied by one American maker, most cresylic acid was imported from England, but because of the strike imports lagged much behind and there was an increase in price. This was, however, offset because of the German cresylic-acid imports at lower prices than the English. Besides keeping the price down these imports supplied more than the entire needs of the country. This refers only to that grade of cresylic acid which is imported free of duty. The special low-boiling grades and the U.S.P. cresol are scarce and in demand due to the reasons previously mentioned.

The market for refined naphthalene has not been satisfactory, because of overproduction and consequent low prices during the past year with the same prospect for the coming season. Crude naphthalene was selling at a low level a few months ago, but because of the British coal strike the prices have risen beyond the prices the refiners can afford to pay, thus forcing them to use the lower grades of domestic crudes.

Ordinarily, it has been a problem to dispose of pitch and tar satisfactorily. In periods of low-market prices, the steel works find it cheaper to use it for fuel. With the tar refiners, the pitch for roofing and road work has been more or less seasonable, causing some inconvenience. This year, however, a demand for briquetting pitch, estimated at 100,000 to 150,000 tons, was called for from Europe, which taxed every tar distiller to capacity, causing an increase in the price of both pitch and tar, which will probably run well into 1927.

Overproduction of U.S.P. phenol caused a considerable drop in prices during the year. It appears that the producers were curtailing their output, hence the prospects are for better conditions next year. Anthracene has been almost inactive with little demand throughout 1926.

All in all, the prospects for the coal-tar products industry during 1927 seem to be auspicious, promising new business as satisfactory as has been the past.

Byproduct Coke Industry Makes Another Record

Editorial Staff Review

PRODUCTION of byproduct coke and coke byproducts in 1926 increased by about 11 per cent as compared with 1925. The production of beehive coke in 1926 exceeded that in the preceding year by only about 1 per cent. Significant figures for the industry are as follows:

	Coal Used, Tons	Coke Produced, Tons
In beehive ovens	18,100,000	11,500,000
In byproduct ovens	63,700,000	44,500,000
Total	81,800,000	56,000,000

The byproduct coke production was 79.5 per cent of the total. Of the byproduct coke plants those associated with iron blast furnaces produced about 82.5 per cent of the output.

During 1926 byproducts were produced in the following amounts:

Byproduct screenings and breeze, tons	3,900,000
Tar, gal.	535,000,000
Ammonia, sulphate equivalent, tons	700,000
Gas, M cu.ft.	710,000,000
Crude light oil, gal	162,000,000

At the end of November, 1926, there were 76 plants producing byproduct coke and coke byproducts. These plants were operating at about 92 per cent of their rated capacity which is the upper practicable limit. The daily rate of output at this time was with one exception the highest on record. This indicates that any threat of curtailment in metallurgical or other industrial activities had not then tended to curtail activity. The curves of Fig. 1 show how the daily average coke production during the past year has compared with preceding years. It is evident that production has not only been record breaking in magnitude, but unusually uniform.

Details are given in Table I as to the production and disposition of byproducts obtained from coke-oven operations in 1925, the latest year for which complete figures are available. Of the tar produced but not sold, 50 per cent of the total, practically all was used by the producer or an affiliated company in open-hearth or other metallurgical furnace firing. Only 5,000,000 gal., 1 per cent of the total production, was used for boiler firing by the producers; but some of the tar sold was so used by purchasers. Of the gas produced only 41.6 per cent was required for heating in 1925. This is the

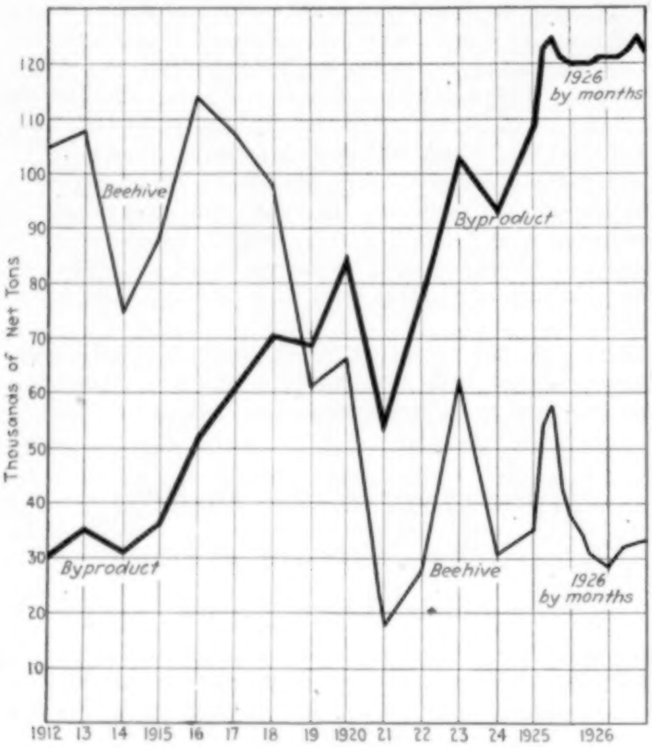


Fig. 1—Average Daily Production of Coke in the United States

lowest requirement ever maintained for an annual average. The improvement is due only in part to improved heating; in part it is due to the fact that coal of higher volatile content, yielding a greater volume of gas, is now generally used, with a consequent greater bulk of "surplus" gas. As in former years the gas wasted was small, 1.8 per cent of the total production in 1925 and probably not greater than this in 1926.

Yields of byproducts probably did not differ materially in 1926 from 1925, but to some slight extent there were increases in average yields made possible by the increasing number of new, and therefore more efficient, ovens. The average yields of byproducts, the average monetary return to the producer from byproducts, and the average receipts by the producer per unit of byproduct sold are given in Table II for 1925.

At the beginning of 1926 there was in existence 11,413 byproduct coke ovens and 429 under construction. Substantially all of those under construction at the beginning of the year are already operating at capacity and a number of other plants started during the year are either already in operation or will be shortly. Hence there are now in use approximately 12,000 byproduct coke ovens and a considerable number of other new ovens under contract or construction which will be operating before the end of 1927. It is notable that a very large percentage of the new ovens is being built by city-gas works or by other companies who intend to market the surplus gas for sale through city public-utility systems. The interlocking of byproduct coke and city-gas industries is, therefore, becoming constantly more intimate.

Table II—Yields and Values of Coke Byproducts in 1925
(Data from U. S. Bureau of Mines)

	Yield per Ton of Coal Treated	Value, F.o.b. Works, per Unit Sold	Value per Ton of Coke Made
Coke	1,398 lbs.	$5.28 per ton*	$5.28
Screenings and breeze	124 lbs.	2.52 per ton*	.22
Tar	8.4 gal.	4.9c. per gal.	.59
Ammonium sulphate	22.4 lb.	2.3c. per lb.	.69
Light oil	2.9 gal. (a)	10.3c. per gal.	.54
Gas—total	11.2 M cu.ft.	....	....
Gas—surplus	6.5 M cu.ft.	17.0c. per M	1.54
Total value of coke and byproducts			$8.86

* Values for coke and breeze per ton are for both coke sales and coke used by producer.
(a) Average for plants recovering light oil.

Table I—Byproducts Obtained from Coke-Oven Operations in 1925

Product	Unit	Production	Sales: Quantity	Sales: Value: Total	Sales: Value: Average
Tar	Gallons	480,848,814	240,160,986	$11,903,196	$0.049
Ammonia:					
Sulphate	Pounds	1,017,014,550	989,676,520	22,546,908	.023
Ammonia liquor (NH_3 content)	Pounds	65,255,767	54,809,335	4,966,885	.091
		....	....	27,513,793	......
Sulphate equivalent of all forms	Pounds	1,278,037,618	1,208,913,860	....	......
Gas:					
Used under boilers, etc.	M cu.ft.	(a) 639,644,062	25,239,072	1,451,253	.057
Used in steel or affiliated plants	M cu.ft.		230,030,325	26,380,657	.115
Distributed through city mains	M cu.ft.		77,457,262	29,319,309	.379
Sold for industrial use	M cu.ft.		29,527,613	4,333,000	.147
			362,254,272	61,484,219	.170
Light oil and derivatives:					
Crude light oil	Gallons	(b) 146,443,106	10,201,900	1,052,585	.103
Benzol, crude	Gallons	6,119,160	5,907,106	1,321,597	.224
Benzol, refined	Gallons	16,231,714	15,909,280	3,566,643	.224
Motor benzol	Gallons	81,469,925	80,957,983	13,441,422	.166
Toluol, crude	Gallons	127,584	46,789	10,052	.215
Toluol, refined	Gallons	5,329,560	4,991,358	1,300,734	.261
Solvent naphtha	Gallons	4,744,431	3,993,735	805,251	.202
Other light oil products	Gallons	2,366,246	1,252,451	96,073	.077
		(c) 116,388,620	123,260,602	21,594,357	.175
Naphthalene:					
Crude	Pounds	9,238,890	9,692,185	92,369	.010
Refined	Pounds	1,018	208,332	5,124	.025
		9,239,908	9,900,517	97,493	.010
Other products		....	....	132,466	......
Value of all byproducts sold		....	....	(d) 122,725,524	......

(a) Includes gas wasted and gas used for heating retorts.
(b) Refined on the premises to make the derived products shown, 143,296,567 gallons.
(c) Total gallons of derived products.
(d) Exclusive of the value of breeze production, which in 1925 amounted to $8,945,345.

Increased Capacity for Synthetic Ammonia in 1926

Editorial Staff Review

NITROGEN has continued during 1926 as politically the most important chemical element in world affairs. Every nation that aspires to industrial importance has undertaken to make itself independent of outside sources of nitrogen, both for its peace-time agricultural and industrial needs and for war-time military requirements.

In Table I are given estimates for the world production of nitrogen, both for the last fertilizer year, ending May 31, 1926, as calculated by the British Sulphate of Ammonia Federation and for the calendar year 1926, as estimated by *Chem. & Met.* The apparent consumption of nitrogen in the United States during 1926 was approximately 283,400 net tons of contained nitrogen. The relationship of the past year's production, imports, and exports to the preceding years is graphically shown in Fig. 1; and Table II gives details for the United States for the year 1926 as nearly as they can be estimated at this time. The table and chart on page 7 give the source and disposition of *ammonia* nitrogen compounds in accordance with the system used regularly by *Chem. & Met.* for this purpose.

Table I—World Production of Nitrogen
(In tons of 2,240 lb. of contained nitrogen)

	Fertilizer Year 1925–26 Tons	Fertilizer Year 1925–26 Per Cent	Calendar Year, 1926 Tons	Calendar Year, 1926 Per Cent
Synthetic	588,000	47	660,000	52.5
Byproduct	333,000	27	340,000	27.5
Chilean nitrate	324,000	26	255,000	20.0
Total	1,245,000	100	1,255,000	100

Although Chilean nitrate accounts for only about 20 per cent of the world's supply of nitrogen it still provides over 50 per cent of the United States supply. Conditions in the Chilean nitrate industry are, therefore, of great importance to nitrogen producers and users in this country. The following are significant figures for that industry:

	Production in Chile, Metric Tons	Exports from Chile, Metric Tons
1925	2,520,000	2,470,000
1926	2,040,000	1,640,000
Decrease	480,000 or 18.5 per cent	830,000 or 34 per cen
	Imports into United States	Re-Exports from United States
1925	1,112,000	9,043
1926	920,000	9,000
Decrease	92,000 or 8 per cent	43 or 0.5 per cent

At the end of November, 1926, only 31 officinas were operating in Chile as compared with 91 a year ago. The visible world stocks of Chilean nitrate at that time were approximately 1,870,000 metric tons, or 11 per cent greater than a year before. This visible stock now represents more than a full year's export. The price of Chilean nitrate during the present nitrate year has been reduced one shilling per metric quintal, that is about 5 per cent less than in the preceding year. This price, however, represents a much higher unit cost of nitrogen contained than do the prevailing prices of ammonium sulphate; and much of the loss of business of Chilean producers has probably been due to this fact.

At the end of 1926 about eighty synthetic ammonia plants were in existence in the world, ten of them in the United States. Both in the United States and in the world as a whole, direct-synthetic ammonia plants represent the greatest operating capacity. There were forty-four such plants in the world, eight of them in the United States, operating at the end of 1926 at the rate of about 500,000 short tons of nitrogen per year, about 17,000 tons of this in the United States. The total capacity of such plants built and building was about 785,000 short tons of nitrogen per year, of which 30,000 tons is located in the United States. These totals include the two great German plants which now have a capacity of 400,000 tons, but are being enlarged to give a total capacity of 500,000 tons.

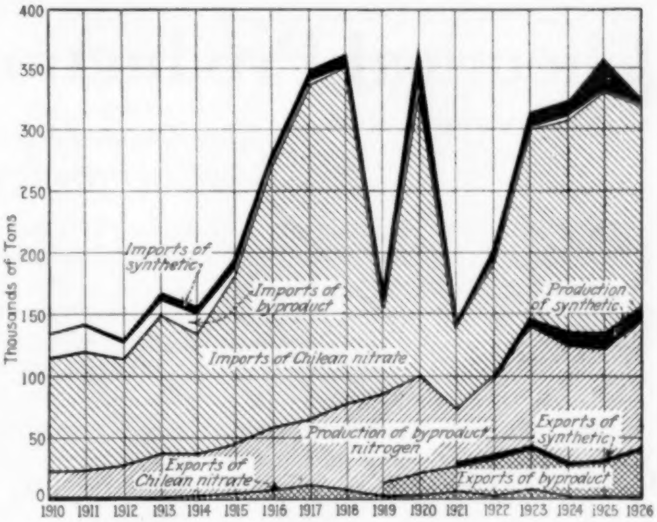


Fig. 1—United States Nitrogen Supply and Exports, 1910-26
Data (except 1926) by F. A. Ernst of Fixed Nitrogen Research Laboratory

In the United States there is one arc plant operating at a capacity of about 300 tons of nitrogen per year. There are six other arc plants elsewhere in the world of 50,000 tons total capacity; they are operating at about 80 per cent of this capacity at the end of the year. The one cyanamide plant in the United States at Muscle Shoals, with a rated capacity of 40,000 tons of nitrogen per year, was idle throughout 1926. In the world there are 30 such plants built or building with a total world capacity of 365,000 tons of nitrogen which at the end of the year is being used at the rate of about 165,000 tons per year.

The total world capacity of all synthetic nitrogen plants is now about 1,200,000 tons of nitrogen, of which 70,300 is in the United States; but the operating rate at the end of 1926 was 725,000 tons for the world, including 17,800 tons in the United States. Of the present capacity built or building about 400,000 tons was added or erection begun in 1926.

Agriculture continues to be the principal user of nitrogen. According to British Sulphate of Ammonia Federation estimates 88 per cent of the world's nitrogen supply goes into agriculture; but *Chem. & Met.* estimates for the United States indicate that only about 60 per cent of the total nitrogen supply is so used, 36 per cent in domestic and 24 per cent in export.

Table II—U. S. Nitrogen Supplies in 1926
(In tons of 2,000 lb. of nitrogen contained)

	Import or Production	Export	Net Available Tons	Net Available Per Cent
Byproduct production	145,200	38,800	106,400	37½
Synthetic production	12,800	1,800	11,000	4½
Chilean nitrate imports	160,700	1,500	159,200	56
Ammonium sulphate imports	2,000	......	2,000	1
Other nitrogen fertilizer imports	3,000	......	3,000	1
Total	323,700	42,100	281,600	100

Chemical Production Establishes Record

Active Demand from Consuming Industries Served To Prevent Accumulations of Stocks

CONSUMING requirements for chemicals reached record proportions last year and this was met by the largest production in the history of the trade. Large contract placements in the latter part of 1925 gave promise of heavy consumption in 1926 and throughout the latter year, new business came to hand in sufficient volume to cause a steady flow of materials from producing to consuming points.

With few exceptions the large supply of stock was taken from the market with no piling up of surplus holdings. An exception might be found in the case of ammonia products where the increase in the number of producers was reflected in an oversupply of aqua and anhydrous ammonia. The latter was a continuance of the condition which arose in 1925 when producers of synthetic ammonia entered the market. For the majority of chemicals large amounts were ordered out regularly against contract commitments and new business absorbed the remainder of offerings.

Operations in the industries which are the principal consumers of chemicals may be inferred from an examination of the weighted indexes for employment in those industries. These indexes are compiled by the Bureau of Labor and taking them as a basis substantial increases are indicated in the amounts of chemicals consumed last year in the glass, leather, fertilizer, paper and pulp, and petroleum refining industries. Moreover actual production of chemicals takes a higher standing than was reached in 1925. Trade estimates for sales of such important chemicals as sulphuric acid, caustic soda, and soda ash agree on an expansion in distribution during the year, the degree of expansion varying according to the relative positions of the industries which were principal buyers.

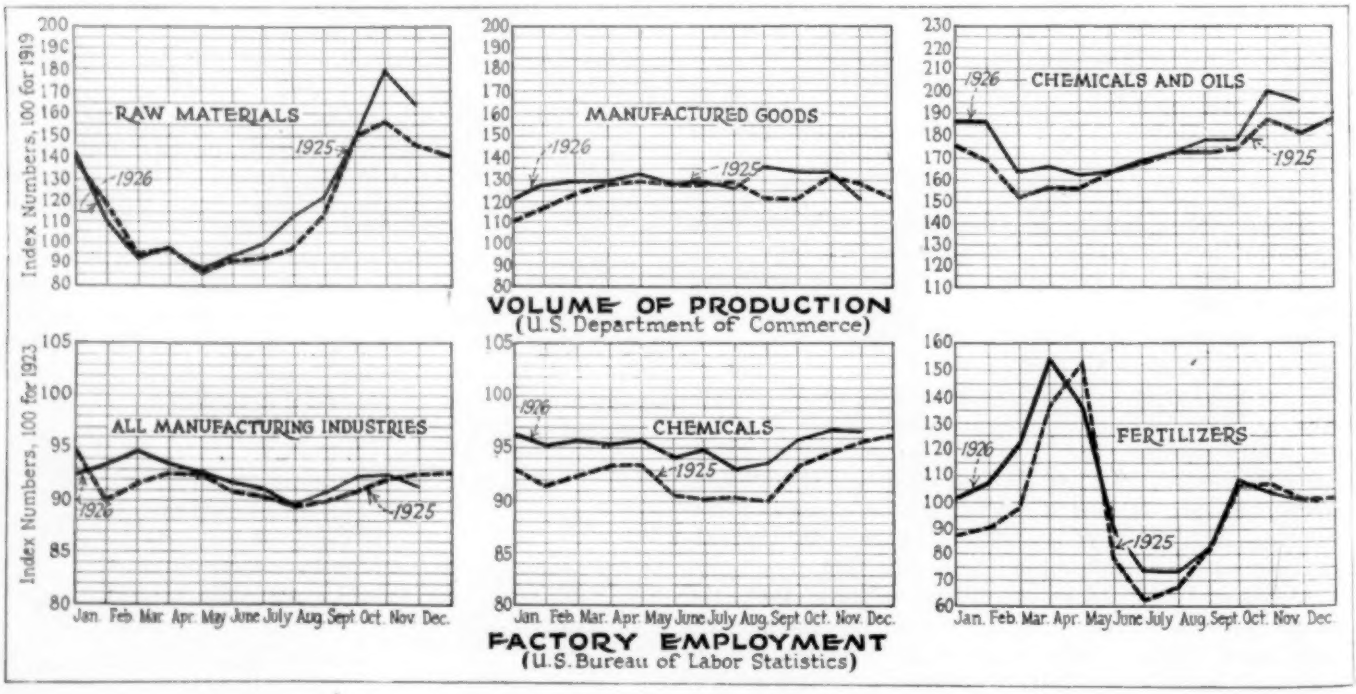
WEIGHTED INDEX OF EMPLOYMENT

	Average Weighted Index 1926	Average Weighted Index 1925
Dyeing and finishing textiles	97.7	99.4
Leather	91.1	90.1
Paper and pulp	94.8	94.4
Chemicals	95.2	92.4
Fertilizers	105.2	98.5
Petroleum refining	98.4	93.9
Glass	99.0	92.9
Automobile tires	109.6	112.3
General average	98.9	96.7

STEADY PRICE MOVEMENT

Trading in chemicals throughout the year was unusually free from drastic fluctuations. The weighted index number at the close of the period was slightly under that reported in January but the difference was small enough to emphasize the general steadiness of values. Among the groups in which net price changes occurred mention may be made of the wood distillation chemicals. The higher levels reached for the latter testify to the recovery of the industry from the confusion into which it was thrown in the preceding year when the menace of foreign synthetic products hung over the market. The alkalis are another group in which price changes have attracted attention. Lower prices in the latter part of the year gave an unsettled appearance to the market and caustic soda and soda ash were under selling pressure which was attributed to changes in sales methods on the part of some of the prominent interests. Aqua and anhydrous ammonia failed to improve their positions during the year and it is difficult to see how the market can be stabilized until a closer adjustment has been made between production and consumption.

The price movement of vegetable oils and fats was in sharp contrast to that presented by the chemical products. The trend was sharply downward. The prime reason for this is found in the unusual variations in value for cottonseed oil. In



Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**113.76**
Last month	113.71
January, 1926	113.86
January, 1925	112.69

Higher price schedules for January delivery of denatured alcohol had much to do with strengthening the weighted index number as other changes were largely among the minor chemicals with scarcely any effect on the weighted number.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**127.35**
Last month	128.94
January, 1926	154.79
January, 1925	154.02

While crude and refined cottonseed oils reached higher price levels during the month, the price index for oils and fats was influenced to a greater degree by declines in linseed oil and other oils and a net decline of .59 points was recorded.

the summer months a rapid run-up in prices resulted from the belief that the supply of oil would prove inadequate for consuming needs until such time as new crop oil would be available. This was followed by reports of a record production of cottonseed which indicated an oil production far in excess of anything which ever had been marketed. Under this influence prices for cottonseed oil and all competing oils and fats fell to very low levels and only partial recoveries from the low points had been registered by the end of the year.

Tariff Developments

The most important development in the way of changes in tariff was found in the case of methanol. A petition for an increase in the import duty had been made by domestic producers of this chemical. The petition brought about an investigation by the Tariff Commission and on Nov. 27 the President issued a proclamation which granted an increase of 50 per cent in the duty on this material. A petition also had been made for higher duty on importations of tartaric acid and an investigation was ordered but no decision has yet been rendered.

Export shipments of chemical products for the first 11 months of 1926 were valued at $113,336,628 as compared with $104,760,048 for the corresponding period of the preceding year. As the unit value was a little lower than in 1925 it is obvious that the gain in volume was larger relatively than that for valuation. The more active position of export trade was one of the most important features of the year and under the stimulus of the Department of Commerce attention of producers was drawn more generally to the development of trade with foreign countries with the possibility that continued progress may be made in that direction. Imports of chemicals for the 11-month period were valued at $124,878,158 which contrasts with a value of $128,348,307 for the corresponding period of 1925.

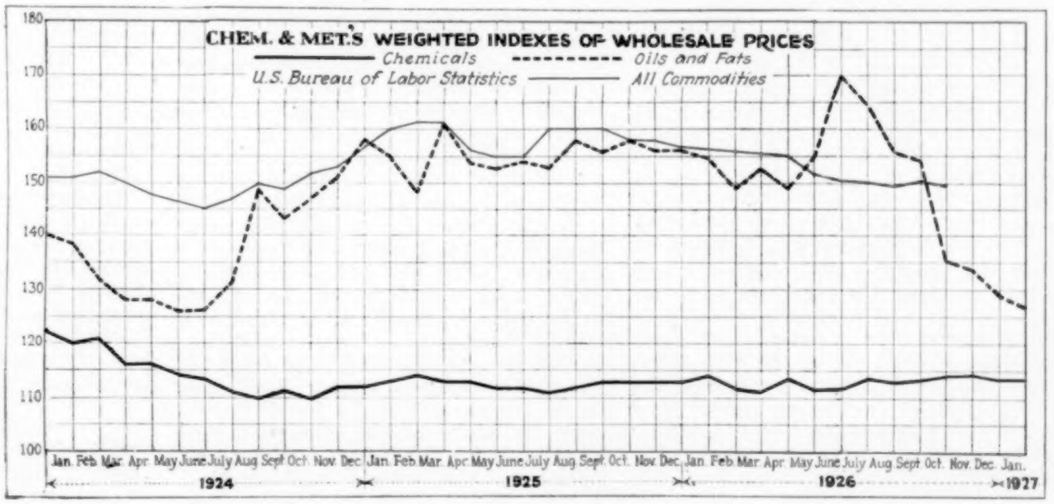
In connection with the application of the flexible provision of the Tariff act, an important question was raised by an application made by an importing company. This application that the Tariff Commission make known to the company the costs of producing a certain chemical in the United States. The commission had conducted an investigation into production costs of this chemical in this country and in Europe and had granted a 50 per cent increase in the import duty as a result of the investigation. The importing company issued a writ of mandamus to compel the commission to disclose domestic production costs as it had found them. The Court of Appeals ruled against the importer but an appeal was taken and a decision from the United States Supreme Court is expected early in 1927. The point involved is very important as the disclosure of domestic production costs would practicaly nullify the operation of the flexible law.

Depression in Nitrate of Soda

The increasing production of nitrogenous materials by synthetic methods in Europe proved to have a depressing influence on the nitrate of soda industry in Chile. To begin with there was a marked falling off in buying orders for nitrate from European countries. Late in the year the United States began to limit its purchases with the result that total shipments from Chile to all points fell far below the normal standards. As stocks of nitrate began to pile up at producing points and at shipping terminals, the number of oficinas in operation in Chile was steadily reduced. Under such conditions the industry was far from prosperous and no relief had been obtained up to the close of the year.

The falling off in demand for nitrate of soda on the part of the United States was due only in part to conditions outside the country. The unusually large crop of cotton with the resultant drop in prices had given an unfavorable aspect to prospects in the coming season for a large consumption of fertilizer materials. It is generally held that some curtailment of production will take place in the fertilizer industry in 1927 and this would naturally tend to slow up buying of nitrate of soda as well as other fertilizer raw materials.

The outlook for other chemicals is favorable. Consuming industries are active and contract placements have run to large tonnage. Judging by car requirements for shipping, the movement of chemicals in the first quarter of the year will be about the same as it was a year ago.



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Increase in Consumption of Caustic Soda

The expanding use of caustic soda in domestic industries was again apparent last year when almost 36,000 tons more than in 1925, passed into home consumption. This increase was brought about by greater activity in the trades which are larger consumers of caustic rather than by any new outlets which were developed. It was stated, however, that there was a larger demand than in preceding years for liquid caustic soda and in some cases where the consuming plant was favorably located, a pumping system was inaugurated between producing and consuming works. Soap makers continue to hold first place in the ranks of consumers but relatively higher gains in consumption were recorded last year in the manufacture of chemicals and rayon.

The following figures show domestic production of caustic soda for the years enumerated, the totals for 1914, 1919, 1921, 1923 and 1925 being based on census data and those for 1924 and 1926 being based on trade estimates:

PRODUCTION OF CAUSTIC SODA

1914	291,539 tons
1919	312,736 tons
1921	238,591 tons
1923	430,961 tons
1924	408,000 tons
1925	497,000 tons
1926	533,000 tons

There was not much change during the year in amount of caustic soda shipped to foreign countries. The same holds true regarding countries of distribution. The Far East headed by Japan ranks first among export buyers with South America, Mexico, Canada and the West Indies holding prominent places. Exports for the last 7 years were as follows:

EXPORTS OF CAUSTIC SODA

1920	229,146,363 lb.
1921	101,021,827 lb.
1922	146,739,406 lb.
1923	114,683,728 lb.
1924	92,115,631 lb.
1925	100,954,500 lb.
1926*	92,069,629 lb.

*11 months ended November.

With a large part of trading in caustic soda done on a contract basis, there is very little fluctuation in market quotations. It has been the custom of sellers late in the year to announce the schedule of prices which is to govern sales over the following 12-month period. This custom was followed in 1925 and sales for 1926 were on a uniform basis with the exception of transactions, especially for export, into which private terms entered. Toward the close of 1926 prices for 1927 deliveries were named but they lacked the uniformity of preceding years and considerable competition for domestic trade developed with the result that sales were made at varying prices.

Smaller Bromine Production in 1925

The quantity of bromine recovered from natural brines and sold or used in 1925 by the producers of salt amounted to 1,566,130 pounds, valued at $488,406, according to reports made to the Bureau of Mines. This is a decrease of 23 per cent from the quantity reported in 1924. Brines in Michigan, Ohio, and West Virginia furnish the bromine.

Calcium chloride, including calcium-magnesium chloride, recovered from natural brines in 1925 amounted to 67,870 short tons, valued at $1,386,639, an increase in quantity of 15 per cent, and was recovered from California, Michigan, Ohio, and West Virginia brines.

Consumption of Arsenic Gains in Volume

One of the most encouraging features to trading in arsenic consisted in the improved statistical position. In other words, actual consumption of arsenic last year was larger than the supply made available by domestic production aided by imports. This makes allowance for the fact that part of the arsenic consumed during the year was in the form of calcium arsenate. The fact remains, however, that consumption of arsenic, as such or in manufactured form, exceeds the available supply for the year. Domestic production of arsenic is estimated at 5,800 tons and imports for the 11 months ended November were 15,063,169 lb. This would give a total supply of 13,300 tons. At the beginning of the year stocks of arsenic in producers' hands were reported at approximately 9,800 tons. At the close of the year stocks were only 4,400 tons, thus proving that surplus holdings had been drawn upon to satisfy consuming needs. Furthermore, holdings of calcium arsenate were considerably lowered during the year, thus adding to the total consumption of arsenic, Trade estimates place total consumption of arsenic at 21,000 tons or 2,000 tons in excess of the total for 1925.

Market values for arsenic were very weak in the early part of the year with no stable price and buyers practically able to dictate their terms. Sales were made under 3c. per lb., after which quotations were advanced and maintained at 3¾c. per lb. The low price level has practically confined arsenic production to the by-product works but the prospects for higher prices seem to depend largely on the market for calcium arsenate and the latter is problematical.

Acetate of Lime Improved Statistical Position

A comparison of the stocks of acetate of lime in sellers hands at the close of the first quarter of the year and at the close of November, shows how greatly the statistical position of this chemical improved as the year progressed. The reduction in stocks did not follow as a result of a lessening in production and as export trade fell below that of 1925, it is evident that domestic consumption of acetate of lime was on a larger scale.

Production of acetate of lime for the past 2 years shows the following:

PRODUCTION OF ACETATE OF LIME

	1925 Lb.	1926 Lb.
January	11,589,955	13,516,733
February	10,414,270	12,074,333
March	11,372,813	13,364,180
April	11,580,597	13,901,334
May	12,269,654	13,150,578
June	10,821,839	10,937,237
July	11 448,631	10,689,942
August	11,971,359	11,845,334
September	11,114,339	11,406,121
October	11,093,858	13,575,272
November	11,201,798	13,828,855
December	13,747,294	
	138,626,437	139,966,153

SHIPMENTS ACETATE OF LIME

	1925 Lb.	1926 LB.
January	10,048,474	11,037,725
February	9,611,100	10,358,455
March	10,886,087	9.660,149
April	9,182,209	11.348 920
May	12.631,276	13,162,397
June	12,811,614	11.998,791
July	10,389,589	14.252,392
August	11,402,040	13,979,012
September	12,334,945	11,025,041
October	12,224,031	15,627,893
November	12,011,964	15,297,856
December	17,143,596	

STOCKS OF ACETATE OF LIME

	1925 Lb.	1926 Lb.
January	15,367,465	17,238,374
February	16.214,894	18,969,188
March	17,382,596	22,594,493
April	19,130,254	24,980,171
May	18,817,017	27,789,106
June	16,678,074	25,573,114
July	17,760,129	22,067,711
August	16,803.815	19,856,591
September	15,083,650	23,042,820
October	13.536,632	17,505,258
November	12,805,960	16,217,967
December	15,215,444	....

Market prices for acetate of lime were on a steady basis for the greater part of the year. As the situation and demand increased with a corresponding decline in surplus stocks, prices were advanced and closed at a net advance for the year. The range in prices for acetate of lime for the last 6 years was as follows:

	High	Low		High	Low
1926	$3.50	$3.25	1923	$4.00	$3.50
1925	3.25	2.75	1922	3.50	1.75
1924	4.00	3.00	1921	2.00	1.50

Nitrate of Soda Depressed By Synthetic Products

Adverse conditions have been the rule in nitrate of soda industry during the past year. The underlying reason rests in the development of synthetic nitrates which have undersold the natural material in many of the large consuming markets. European countries have taken the lead in making use of air-fixation nitrates, and, according as the supply of the latter increased, there was a corresponding decline in their orders for the Chilean product. With synthetic nitrate production on an established basis and, in fact, promising to expand, the situation with regard to future demand for nitrate of soda offers complications which may not be easily adjusted. Reduced to its simplest terms, the situation is that consumers have been able to purchase nitrogenous materials on a cheaper basis than they could do by purchasing nitrate of soda at the prevailing prices. Hence there was a widespread curtailment of buying orders for nitrate of soda.

The effect in primary markets was to cause a big increase in surplus stocks which forced a more or less gradual falling off in production. At the begining of the year there were 89 oficinas in operation in Chile. Every month saw a falling off in the number of working plants and by September the number had dwindled to 43. Shipments of nitrate from Chile in January were 248,000 metric tons while those for September were only 83,806 metric tons.

Attempts were made by producers of Chilean nitrate to place the industry on a firmer footing but no substantial results were attained. It was proposed that the Chilean government remove the export tax from nitrate but this was not approved by the government. Attempts also are being made to lower the price for sodium nitrate by economies in the production end. In this connection it is noted that a large new plant will operate during the coming year, using a new process for which lower cost of operation is claimed. The company is reported to have requested the Nitrate Producers Association to grant them a sales quota allotment of 600,000 metric tons, which amount is equivalent to approximately 30 per cent of the total world consumption of Chilean nitrate during the fiscal year 1925-26. Prominent factors in the Chilean industry are said to anticipate that the association will decline the request. They predict that the association will be forced to dissolve at the close of the current fiscal year and that after July 1, 1927, individual producers will make their own selling prices.

A new schedule of prices for the nitrate year was announced in June. These prices were slightly lower than had been in effect in the preceding year. The quoted prices, however, did not have the effect of stabilizing asking prices for spot goods in consuming markets and at times resale lots were offered at relative figures. In the New York market spot nitrate was offered as low as $2.33 per 100 lb.

The United States proved to be the largest buyer of sodium nitrate and arrivals at domestic ports were heavy in the first part of the year. Whether or not influenced by conditions in European markets or possibly by the poorer outlook for fertilizer consumption as a result of the fall in prices for cotton, domestic buyers cut down shipping orders in the latter part of the year and arrivals for the 11 months ended November were 850,635 tons as against 1,069,208 tons in the corresponding period of 1925.

Regular Contract Deliveries of Liquid Chlorine

Domestic production of liquid chlorine in 1925 was placed at 55,000 tons in the returns as published by the Bureau of the Census. This represents an increase of 5,000 tons over the total for the preceding year. Further gains in production were reported in 1926 but no definite figures are available. The outlet afforded by chlorine is still not large enough to precent accumulations where manufacturers of electrolytic caustic soda attempt to accept all available business in the latter. The active call for caustic soda last year at times resulted in accumulations of chlorine and put a check on manufacturing operations. In spite of this demand for liquid chlorine has been expanding in recent years and the outlook for future growth is regarded as promising.

The year was uneventful in the way of price changes with the exception of a general higher average price obtained on small lot business. On contract business, and this accounted for the greater part of the total sales, sellers have adopted a policy of establishing a price once a year and this level is maintained throughout the year.

Sales of Soda Ash Gained in Volume

Trading in soda ash in 1926 was featured by an increased call from consumers which resulted in a gain of almost 10 per cent over 1925 in the amount shipped from producing points. More than one-half this increase over the preceding year was credited to unusually heavy demands from glass makers who are credited with a consumption of 665,000 tons for the year. Census figures give sales of soda ash in 1925 as 1,368,660 tons as compared with 1,258,780 tons in 1923. Private figures place sales in 1926 at 1,520,000 tons, thus indicating an increase of about 10 per cent over the 1925 total. Practically all consuming industries were more active in 1926 and this accounts for the expansion in the consumption of ash.

In addition to the larger call for soda ash at home a substantial increase was noted in the tonnage shipped to foreign countries with Canada taking a large percentage of these shipments. The export trade in ash for the last 7 years compares as follows:

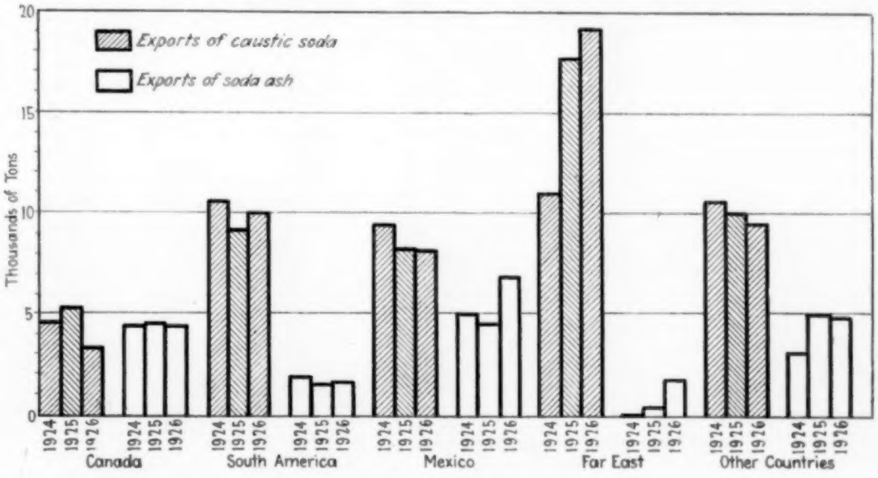
Exports of Soda Ash

	Lb.
1920	116,555,500
1921	113,481,062
1922	33,090,180
1923	29,023,704
1924	28,683,396
1925	32,380,108
1926*	36,008,849

* 11 months ended November.

The prospects are favorable for a large consumption of soda ash during the coming year. This is predicted not only on the position of manufacturing industries for which ash is an important raw material but also on the fact that a large part of the year's output already has been sold on contract. New contract prices which were named late in 1926 met with a ready response from buyers and the trading movement was accelerated by the fact that sellers were willing to accept lower prices than had obtained on 1926 deliveries. The lowering of prices formed one of the interesting developments of the year. Apparently production costs have not changed to any extent which would warrant a lower selling level and the turn in buyers favor was attributed to keener competition on the part of producers. Soda ash, light 58 per cent is offered in bulk at $1.17½ per 100 lb. on contract with the price in bags at $1.32½ per 100 lb. Dense ash in bags was offered on contract at $1.37½ per 100 lb.

Export Trade in Caustic Soda and Soda Ash by Countries



Methanol Placed on More Favorable Basis

Developments last year in the market for methanol took a turn for the better as far as domestic producers are concerned. In the first place there was no heavy importation of the synthetic product and foreign producers apparently made no effort to capture domestic markets. It is true that fairly regular arrivals reached this country from Germany but they represented contract deliveries and did not offer competition in the open market. Furthermore they accounted for only a small percentage of domestic consumption and the bulk of home requirements was dependent on the domestic wood distilled product. In the second place the opinion gained ground that the danger from a domestic synthetic production of methanol was not immediate. A third development of importance took the form of greater protection from foreign producers when the import duty was increased from 12c. to 18c. per gal. The higher duty became effective under the flexible provisions of the Tariff act and was granted in response to a petition which had been made by domestic producers. Encouragement in the belief of a larger use of methanol in the coming year also was given by a change in the formula for denaturing alcohol to be used for industrial uses. This change calls for a doubling of the amount of methanol to be used as a denaturant and should result in a corresponding increase in the total amount of this product used in denaturing. Toward the close of the year the possibility of the new formula being put into operation was rendered doubtful by an agitation to dispense with methanol as a denaturant because of the toxic effect where the denatured product is used for potable purposes. The agitation, however, failed to bring about any adverse legislation or ruling. Attempts were increased, however, to develop a non-poisonous denaturant.

Export trade in methanol also failed to find competition in the majority of outside markets. During the 11 months ended November export shipments reached a total of 408,561 gal. as compared with 408,185 gal. during the entire year which preceded.

As a result of the improved condition which prevailed market values for methanol appreciated during the year. Opening the year the quotation for 95 per cent material was 57c. per gal. while at the close the asking price was on a basis of 80c. per gal.

Production of refined methanol, as reported by all the methanol-refining plants in the United States, was 577,718 gal. in November as compared with 585,122 gal. in October and 656,641 gal. in November, 1925. The following table shows figures for the United States and Canada for each month of 1926, and from April, 1925, to November, 1925, inclusive, and comprises the following grades of methanol: 95 per cent refined methanol, 97 per cent refined methanol, pure methanol, C. P. methanol and denaturing grade methanol.

METHANOL STATISTICS

UNITED STATES

Year and Month	Crude: Purchased (1) Gal.	Crude: Consumed Gal.	Crude: Stocks (End of Month) Gal.	Refined: Produced Gal.	Refined: Stocks (End of Month) Gal.
1925					
April	430,377	581,181	1,786,150	474,701	719,468
May	390,831	589,223	1,869,677	417,727	717,400
June	336,740	480,057	1,461,989	375,040	672,061
July	395,832	646,490	1,544,175	395,607	556,561
August	435,423	622,570	1,468,549	526,383	577,292
September	454,391	619,782	1,365,088	509,795	527,176
October	681,985	907,452	1,064,365	673,308	516,437
November	597,836	810,607	858,301	656,641	496,792
1926					
January	503,973	731,466	656,565	596,997	637,300
February	516,820	691,730	685,995	483,059	636,699
March	583,085	756,346	750,480	559,505	557,711
April	531,370	633,731	850,999	525,008	623,538
May	604,598	802,337	876,428	477,559	567,4t4
June	677,144	963,093	600,780	652,692	512,606
July	665,854	880,196	279,202	685,201	585,301
August	611,402	714,658	351,409	560,806	385,765
September	675,671	820,504	164,363	663,251	344,629
October	620,792	776,430	151,326	585,122	279,781
November	564,092	725,852	144,136	577,718	235,516
Total	6,554,801	8,496,343	....	6,366,918	....

CANADA

Year and Month	Crude: Purchased (1) Gal.	Crude: Consumed Gal.	Crude: Stocks (End of Month) Gal.	Refined: Produced Gal.	Refined: Stocks (End of Month) Gal.
1925					
April	....	37,928	65,643	36,680	68,477
May	....	26,465	58,648	25,800	50,344
June	....	17,493	55,475	17,200	51,551
July	....	21,641	42,944	20,700	52,459
August	....	....	42,077	....	32,007
September	....	22,188	19,889	21,185	40,129
October	....	12,100	36,606	11,500	32,443
November	....	40,895	33,186	39,200	40,846
1926					
January	....	32,574	40,096	31,545	60,704
February	....	39,570	29,478	38,070	69,371
March	....	30,561	33,089	29,140	72,629
April	....	28,072	22,451	26,995	75,276
May	....	28,537	23,827	27,460	81,259
June	....	13,379	20,664	12,670	76,108
July	....	337	33,827	....	58,465
August	....	....	33,651	....	42,994
September	....	27,685	31,853	26,700	44,303
October	....	30,222	30,293	29,200	40,631
November	....	38,884	18,947	37,500	43,964
Total (11 mos.)	....	269,821	....	259,280	....

(1) Does not include crude methanol produced by refinery.

Nitrite of Soda Finds New Consuming Outlets

Nitrite of soda is included among the chemicals for which an increased consumption was claimed last year. This was due not only to activity in the fields into which nitrite had been accustomed to enter but also to the development of new uses which widened the consuming market for this chemical. In August the U. S. Department of Agriculture issued an announcement in which was defined the materials which could be used in prepared meats and in meat products. Nitrite of soda was among the materials included and it is expected that the coming year will find considerable amounts of nitrite passing to packers.

From the time that the import duty on nitrite of soda was increased, the market has been largely in the control of the domestic product. This was the case last year although importations were larger than they were in 1925. The principal shipping countries were Germany and Norway. The imported material had some influence in establishing market prices as it frequently came in competition with the domestic material. Imports for the first 11 months of 1926 were 1,906,855 lb. valued at $68,989 while for the corresponding period of 1925 imports were 1,189,485 lb. valued at $49,360.

Prices for nitrite of soda fluctuated within rather narrow limits with the range extending from 8¼c. to 9c. per lb.

Late Season Flurry Featured Calcium Arsenate

During the early part of the arsenate season, there was not buying enough to create any change in the market and a dull season seemed to be in prospect. Weevil damage then began to arouse cotton planters and there was a short period when buying reached an active stage and cleaned up most of the stocks held at southern points. At the beginning of the arsenate season, July 1, 1925, the stocks of calcium arsenate carried by producers was reported at 15,558,214 lb. This includes about 70 per cent of the industry, so that total surplus stocks would be somewhat in excess of that figure. The unsold supply had a deterring effect on production and only 5,363,320 lb. were turned out in the fiscal year July 1, 1925-June 30, 1926. The latter figure also represents 70 per cent of the trade, so that total production would be somewhat larger. Stocks on hand June 30, 1926, were 6,172,446 lb. The heavy buying movement, however, came later on and brought a material lessening in surplus stocks. It is estimated that stocks of calcium arsenate at the end of the year were about 5,000,000 lb.

Prices for calcium arsenate were easy in the early part of the year and while 6c. per lb. was quoted, the trading basis was subject to negotiation with the 6c. per lb. level disregarded. When demand became active as high as 11c. per lb. was paid for spot goods in southern markets. The market then returned to a level of 6½c. per lb.

Zinc Oxide Meets With Wider Demand

Domestic consumers of zinc oxide were in the market in an active way throughout the year and an increased tonnage over that for 1925 was reported to have been required to fill requirements of the domestic trade. The rubber trade was in the market for regular monthly deliveries and is reported to have taken more than one-half of the total amount shipped to domestic producers. The paint trade in general compared favorably with that for the preceding year but it is reported that in some quarters there has been a tendency to increase the percentage of zinc oxide used in paints and this is favorable to an increased consumption of the pigment.

Foreign countries likewise showed a preference for zinc oxide and export business showed a material gain over that for 1925. The United Kingdom and Canada proved to be the largest outside buyers but different European countries received sizeable amounts. Export trade in zinc oxide for the last 7 years compares as follows:

	Lb.
1920	30,925,243
1921	10,149,360
1922	6,726,285
1923	10,613,881
1924	7,854,394
1925	21,710,048
1926*	23,518,293

* 11 months ended November.

For many years it has been the custom of leading producers of zinc oxide to quote prices covering delivery over a three-month or six-month period. A large part of the buying was on contract and quotations fluctuated but little. Competition, however, became more of a factor last year and in the latter part of the period asking prices were openly reduced and practically became inoperative because sellers were willing to deal on private terms with the degree of competition influencing values. The year closed with no stable quotation and selling competition promised to continue as a factor in the future market.

Bleaching Powder Moves in Moderate Way

The inroads into consumption of bleaching powder which have been made in recent years by liquid chlorine, again militated against a large distribution of bleach. Both production and consumption proceeded at a rate far below that reported a few years ago. In 1923 production of bleaching powder amounted to 146,975 tons, while present rate of production is less than 100,000 tons a year.

Because of the fact that some of the paper mills make bleaching powder for their own consumption it is difficult to secure accurate figures to represent total production.

Foreign countries also have cut down their demands for bleaching powder and during the first eleven months of 1926 total shipments abroad amounted to 19,717,582 lb., valued at $363,145, which shows a substantial decline from the shipments for the corresponding period of 1925 which amounted to 25,695,063 lb., valued at $437,391.

Prices for bleaching powder held a steady course throughout the year. The general quotation was maintained at $2@$2.10 per 100 lb. in carlots f.o.b. works. Production was held in check to harmonize with consuming requirements and any surplus stocks which may have been held by producers were handled in such a way as to prevent any demoralization of prices.

Bichromate of Soda Holds Steady Price Course

With only three producers of bichromate of soda in the country, competition, nevertheless, continues to be keen enough to hold prices down to relatively low levels. Large quantities of this material had been sold on contract for 1926 delivery on a basis of 6c. per lb. At this figure, it is stated, that some firms can not produce at a profit and the low prices which have prevailed

Distribution of Bichromate of Soda

for bichromate offers one of the main features to the market. Contracts for 1927 delivery also were made at 6c. per lb. and upward on a scale graded according to the amounts involved. Of the raw materials used in the manufacture of bichromate, soda ash is lower than a year ago but this is at least offset by the firmer position of sulphuric acid, while chrome ore has varied very little in value.

Consuming demand for bichromate of soda was uniformly good during the year and producing plants were working practically at capacity. Census figures for 1925 place domestic production of bichromate and chromate of soda at 27,820 tons valued at $3,526,566 as compared with 26,879 tons valued at $3,994,566 in 1923. As production of chromate of soda is unimportant, it is obvious that the greater part of these totals refer to bichromate of soda. In 1926 larger amounts of bichromate are reported to have been taken by the leather and color industries and total production of bichromate is estimated to have exceeded that for 1925. As the totals indicated are close to full capacity of existing plants a sharp rise in total production is not to be expected except through enlargement of plants. A report was current during the year that one producing company would install equipment which would serve to reduce production costs and possibly increase production by eliminating shut downs for repairs.

In addition to a large call for bichromate from domestic industries, buying for export was of a progressive nature. The latest export figures available cover the 11-month period ended November. In that period outward shipments were 7,639,137 lb., valued at $474,336, which contrasts with 6,335,597 lb., valued at $386,675, in the corresponding period of 1925.

Higher Import Duty Sought For Tartaric Acid

Imported tartaric acid is reported to have taken care of about one-half domestic consuming needs in 1925. As imports had been steadily growing, the possibility of market control passing to foreign producers influenced domestic makers, in the first part of last year, to make application for an increase in the important duty under the flexible provisions of the Tariff act. This request was met by the Tariff Commission with the issuance of an order for an investigation. The matter had not come up for decision by the end of the year. Competition from foreign makers, however, became less active and importations for the 11 months ended November were 1,486, 292 lb., whereas in the corresponding period of 1925 they had reached a total of 3,563,677 lb.

Consumption of tartaric acid during the past year was reported to have been of normal proportions and the falling off in importations was made up by a corresponding increase in the home output. This is further borne out by important figures which show that 24,205,275 lb. of crude potassium bitartrate, argols, or wine lees had been brought into the country in the 11 months ended November in comparison with imports of 22,073,740 lb. in the 11-month period of 1925. Hence foreign trade ran more to imports of raw materials than of the acid.

The trend of prices for tartaric acid has been downward for the past 10 years. In 1918 asking prices exceeded 90c. per lb. while the range in 1926 was 28c. to 29c. per lb.

Competition Weakens Lithopone Values

While a logical reason for lower prices for lithopone might be found in lower producing costs, the feature to trading in this material consisted in the keen competition which developed in the latter part of the year. Under this competition rather drastic cuts in quotations were made and on some business was reported to have been negotiated at private terms. In fact some sellers at the close of the year were not attempting to hold any open price but stated that they were willing to meet competition. Consumption of lithopone has been growing but the number of producers likewise has increased and the lower price movement has been largely the result of a greater increase in supply than in demand.

Larger Amount of Sulphur Mined Last Year

While official figures are not yet available, trade estimates place domestic production of sulphur last year at about 1,850,000 tons. This compares with an output of 1,409,240 tons in 1925. Shipments from mines last year were approximately the same as the amount produced so there was practically no change in the volume of stocks carried by producers. As exports accounted for about 600,000 tons, the apparent domestic consumption of sulphur in 1926 was 1,250,000 tons. Domestic production and consumption of sulphur in the last 10 years compare as follows:

	Production Tons	Domestic Consumption Tons
1917	1,134,412	968,615
1918	1,353,525	1,135,672
1919	1,190,575	453,622
1920	1,255,249	1,040,219
1921	1,879,150	668,675
1922	1,830,942	865,920
1923	2,036,097	1,146,780
1924	1,220,561	1,051,544
1925	1,409,240	1,228,469
1926	1,850,000	1,250,000

Stocks in producers' hands at the close of 1925 were reported at 2,250,000 tons and this figure also represented producers' holdings at the close of 1926.

In the latter part of 1925 prices for sulphur were advanced and the trend of values continued upward in 1926. The rise in values in the two year period bringing the quotation at mines from $14 per ton to $19 per ton, the latter figure having prevailed over the greater part of 1926.

Export demand for sulphur was not greatly affected by the rise in the unit price and with the exception of 1925, outward shipments were the largest on record. Exports for the last 10 years were as follows:

	Tons		Tons
1917	152,736	1922	485,664
1918	131,092	1923	472,525
1919	224,712	1924	482,814
1920	477,450	1925	629,401
1921	285,762	*1926	531,665

* 11 months ended November.

Silicate of Soda Exported in Large Amounts

The official returns covering foreign trade in silicate of soda for 1925 illustrated the active call which had been received from foreign markets. Outward shipments in 1926, however, outstripped the totals for any preceding and the growth of this chemical in the export trade was one of the encouraging developments of the year. Domestic buyers also were active and total tonnage movement was reported to have shown a gain over that for 1925. The Bureau of the Census reports a production of 394,824 tons in 1925 and 331,309 tons in 1923. These figures represent production in terms of 40 deg. An active contracting movement was noted in the latter part of the year which is regarded as proof that consumption will be large in 1927. Prices for silicate of soda have shown a range according to grade and seller with private terms entering into many transactions where large lots were concerned. An increase is reported in the number of domestic buyers who are accepting delivery in tank cars. The growth in export shipments of silicate of soda is shown in the following table:

EXPORTS OF SILICATE OF SODA

	Lb.	Value
1920	33,692,535	$420,124
1921	23,099,660	321,972
1922	26,024,366	279,041
1923	31,430,252	308,862
1924	32,225,650	314,082
1925	36,089,562	321,238
*1926	44,760,145	368,061

* 11 months ended November.

Pyroxylin Lacquers Increase 108 per Cent

Hailed three years ago as a revolutionary advance in the finishing of wood and metal surfaces, an unusual future was predicted for pyroxylin lacquers. Few of the industrial prophets, however, could foresee at that time the tremendously rapid rate at which the product was to assume commercial importance. In fact, its growth during the past year, as revealed by recent Census figures, probably breaks all records for industrial expansion. During the first six months of 1926 there were 111 plants in operation, producing 10,136,800 lb. pyroxylin lacquers. In the same period of 1925 there were but 67 plants and the output was 4,880,200 lb. During a single year the pyroxylin lacquer industry had increased 108 per cent!

Such an expansion could not have been possible without a well developed technology in this relatively new field. To equip 44 new plants and to put them in operation is a real tribute to chemical engineering. And with the industry established on such a scale, it is certain to have a marked influence on the continued development of the organic chemical industries that supply the nitrocellulose, solvents, plasticizers, resins and other materials for lacquer manufacture.

Production and Sales Prices for Magnesium Salts

The production of magnesium salts from natural sources in 1925 in the United States was 85,158,000 lb., valued at $1,253,110, according to the Bureau of Mines. Five companies produced 62,227,000 lb. of magnesium chloride, valued at $911,440, from bitterns. Of this quantity 59,788,000 lb. was solid chloride, which sold at $0.0148 a lb., and 2,439,000 lb. was in liquid form from 23 deg. to 36 deg. Baumé, which sold at $0.0109 a lb. Four companies produced magnesium sulphate to the amount of 22,931,000 lb., which sold for $0.0149 a lb. About 90 per cent of the sulphate was made from salt works bitterns and the remainder from natural magnesium sulphate.

Increased Importations of Sal Ammoniac

While there were times when supplies of sal ammoniac were not large enough to fill consuming needs, the situation recently has been reversed as importations have been large and the market was featured occasionally during the last year by offerings of distressed lots at very low prices. Battery makers were active buyers throughout the year. In spite of the free offerings from abroad there are rumors of an increased domestic production and the recent enlargement in domestic production of ammonia is said to have turned attention toward the production of sal ammoniac as a means of taking up some of the surplus output of ammonia. The gain in distribution of foreign sal ammoniac may be seen from a comparison of the import figures which show that imports in the 11 months ended November were 13,290,605 lb. in 1926 and 9,986,687 lb. in the corresponding period of 1925. It is also noted that imports were increasing in the latter part of last year with arrivals of 2,555,490 lb. in November. As imports in the 5 years prior to 1925 averaged only a little more than 5,000,000 lb., the growing demand for this chemical becomes apparent and the prominence of foreign-made material also is accentuated.

That the market did not readily absorb all the sal ammoniac received may be shown by reference to the position of the market at times when unsold lots arrived and were offered as low as 5c. per lb. for white on a basis of ex-dock. Much of the material imported was sold ahead and passed directly to consumers. The prevailing prices for shipments ranged from 5¼c. to 5⅜c. per lb.

Higher Selling Schedules for Potash Salts

Attributed to higher transportation costs a new and higher selling schedule for German potash salts was announced in the latter part of the year. This was followed by a further advance with the result that these products are established on higher levels for 1927 delivery. In the case of muriate of potash the new price is on a basis of $36.40 a ton in comparison with $34.90 a ton which was in effect previously. Sales of potash by the German Potash Syndicate for its fiscal year ended April 30, 1926, were 1,122,615 metric tons in comparison with 1,143,397 metric tons in the preceding fiscal year. American buyers increased their requirements for muriate of potash.

The workings of the foreign syndicate were of interest because of reports of internal friction. One faction was said to have been in favor of closing the plants which were not able to produce cheaply and to advocate a lowering in prices for potash in order to stimulate its consumption. A change in stock holdings in the latter part of the year is said to have caused discontent to such an extent that the disruption of the syndicate was regarded as probable.

Sulphuric Acid Affected By Higher Producing Costs

With the greater part of domestic sulphuric acid produced from sulphur, price developments in the latter market have been of importance to acid makers. Values for sulphur moved upward in 1925 and further increases in the sales price were made in 1926. As a result the contract period for 1927 delivery found buyers of sulphur less favorably situated than they were in the preceding year and a strong tone underlies the acid market. It is probable that production of sulphuric acid from pyrites gained ground during the year. This is indicated by the fact that a slight gain was said to have been made in the domestic output of pyrites and in the 11 months ended November imports were 349,378 tons as compared with 270,157 tons in the corresponding period of 1925.

Export business in sulphuric acid was of larger proportions last year but this accounts for only a small percent of the supply. Imports also were larger with arrivals of 53,069,661 lb. in the 11 months ended November. This compares with imports of 32,524,810 lb. in the corresponding period of 1925. Nearly all the imported sulphuric acid came from Canada.

Production of sulphuric acid was very heavy in the first half of the year but fell off later on as the fertilizer branch of the industry was affected by the depression following the large yield of cotton and the drop in prices for that staple. Total production for the year, however, was larger than in 1925 with the amount estimated at 7,035,000 tons.

Chlorate of Patash Imported in Large Volume

In 1925 the import duty on chlorate of potash was increased 50 per cent, making the rate 2¼c. per lb. This action was taken at the request of domestic producers and was designed to check competition from foreign markets. Official returns for 1925 failed to show where the higher duty had affected the arrival of foreign-made nitrate and the market throughout last year was of interest because it demonstrated that foreign producers still were in a position to compete for domestic business. The official figures of imports for the 11 months ended November were 11,558,497 lb. This total included both chlorate and perchlorate of potash but importations of the latter were not large. The value of these imports was given as $424,204 which works out at an average price of less than 3.7c. per lb. These values may be based c.i.f. foreign port in which case it would not represent a delivered price but in any case it illustrates the low cost of producing chlorate abroad. In the 11 months ended November, 1925, imports of chlorate and perchlorate of potash were 11,677,271 lb. valued at $474,865 or an average value of a little more than 4c. per lb. A large part of imports pass directly to consumers and do not enter the open market. As entire domestic consumption is not much more than the amount imported it is evident that the foreign material still controls domestic markets.

There was very little change in quoted prices for chlorate during the year. On large lots asking prices ranged from 8¼c. to 8½c. per lb. f.o.b. producing works and the usual differentials held good for smaller amounts.

Production of Sodium Salts in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, sodas and sodium compounds to the aggregate value of $110,095,686 were made in the United States in 1925, this being a decrease of 1.6 per cent as compared with $111,848,381 for 1923, the last preceding census year, and an increase of 31.5 per cent as compared with $83,698,199 for 1921.

The table below, shows the products by kind, quantity, and value for 1925 and 1923; the figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

PRODUCTION OF SODIUM SALTS IN 1925

Products by Kind, Quantity and Value1925 and 1923.

The figures shown in the "For sale" columns include data for quantities and assigned values of products consumed by the producers in plants or departments other than those in which they were manufactured, where separate reports for such plants or departments were made.]

	Year	Number of establishments	Unit of measure	For sale: Quantity	For sale: Value	Made and consumed Quantity
Total value	1925	..	...	....	$110,095,686	......
	1923	..	...	....	111,848,381	......
	1921	..	...	....	83,698,199	......
Sodium compounds						
Acetate	1925	6	lb.	813,834	47,583	......
	1923	8	lb.	905,639	59,941	......
Benzoate	1925	6	lb.	708,928	321,656	......
Biborate (borax)	1925	7	ton	49,967	4,083,209	......
	1923	6	ton	53,092	5,102,148	......
Bichromate and chromate	1925	5	ton	27,820	3,526,568	......
	1923	5	ton	26,879	3,994,566	......
Carbonates:						
Soda ash *a*	1925	12	ton	1,368,660	32,243,941	......
	1923	14	ton	1,25[illegible],780	32,427,166	......
Ammonia-soda process	1925	6	ton	1,310,882	30,914,558	539,131
	1923	6	ton	1,225,027	31,413,210	449,207
Natural and electrolytic soda	1925	6	ton	57,778	1,329,383	......
	1923	8	ton	33,753	1,013,956	......
Sal soda	1925	29	ton	63,221	1,322,426	......
	1923	26	ton	68,802	1,690,084	......
Bicarbonate, refined *a*	1925	6	ton	123,472	3,651,848	......
	1923	7	ton	145,316	*b* 3,738,129	......
Citrate	1925	6	lb.	553,181	249,537	9,941
	1923	7	lb.	423,511	273,595	......
Flouride	1925	3	ton	1,252	216,558	......
Hydroxide (caustic)	1925	22	ton	487,145	27,392,352	10,116
In small containers and sticks	1925	..	ton	14,860	2,207,995	......
All other	1925	..	ton	472,285	25,184,357	......
Production by processes:						
Lime-soda *a*	1925	6	ton	353,092	....	2,691
Electrolytic	1925	16	ton	134,053	....	7,425
Hydroxide (caustic)	1923	23	ton	430,961	25,056,547	5,658
Production by processes:						
Lime-soda	1923	6	ton	311,838	....	2,357
Electrolytic	1923	17	ton	119,123	....	3,301
Hydroxide, repacked (purchased in bulk)	1925	12	ton	26,687	4,414,836	......
	1923	12	ton	32,828	5,034,336	......
Hypochlorite	1925	7	ton	12,215	1,877,257	......
In small containers	1925	..	ton	3,916	1,326,401	......
All other	1925	..	ton	8,299	550,856	......
Hypochlorite	1923	8	ton	10,939	758,745	......
Iodide	1925	7	lb.	49,531	194,803	......
	1923	8	lb.	45,450	189,739	......
Nitrate, refined	1925	5	ton	3,127	221,551	......
	1923	4	ton	10,675	870,698	......
Phosphates	1925	14	ton	79,386	5,758,214	......
Tri-sodium	1925	7	ton	48,783	3,288,101	......
Mono-sodium and di-sodium	1925	13	ton	30,603	2,470,113	......
Phosphates	1923	14	ton	36,599	3,171,554	......
Tri-sodium	1923	..	ton	26,224	1,955,632	......
Mono-sodium and di-sodium	1923	..	ton	10,375	1,215,922	......
Silicate (basis 40°)	1925	22	ton	394,824	5,715,026	......
	1923	21	ton	331,309	5,066,719	......
Silicofluoride	1925	8	ton	1,384	128,025	......
	1923	10	ton	2,481	302,758	......
Sulphates:						
Niter cake (sodium bisulphate)	1925	41	ton	100,153	394,833	22,700
	1923	45	ton	129,447	587,897	24,640
Salt cake	1925	35	ton	139,073	2,315,502	48,450
	1923	34	ton	141,017	2,972,013	46,047
Glauber's salt	1925	20	ton	57,176	1,255,570	5,109
	1923	21	ton	66,192	1,521,095	5,940
Anhydrous	1925	5	ton	2,100	128,115	......
	1923	16	ton	3,183	267,518	......
Sulphide	1925	12	ton	18,366	1,067,334	5,399
	1923	19	ton	31,838	2,209,499	6,310
Sulphites:						
Sulphite (normal)	1925	7	ton	4,492	382,728	......
	1923	4	ton	4,382	370,601	......
Bisulphite	1925	10	ton	12,488	609,163	1,266
	1923	10	ton	14,500	677,882	1,713
Hyposulphite (thiosulphate)	1925	12	ton	23,982	1,051,068	......
	1923	11	ton	22,538	1,124,351	......
All other	1925	..	...	....	11,525,983	......
	1923	..	...	....	14,380,800	......

a The production of soda-ash computed on a 58% basis, using the factors 0.631 for sodium bicarbonate and 1.325 for sodium hydroxide (not electrolytic) aggregated 2,512,863 tons for 1925 and 2,243,375 tons for 1923.

b Includes data for some crude bicarbonate of soda.

Over Production Depressed Ammonia Market

Selling pressure became prominent in 1925 in the market for aqua and anhydrous ammonia and last year opened with prices at low levels and competition unabated. The change in conditions was brought about by the introduction of synthetic ammonia on the market. The latter not only disturbed values but also placed additional amounts on sale which disturbed the economic balance of the market. Last year seven works were producing synthetic ammonia with reports that the number was to be further enlarged. With the development of synthetic ammonia at lower costs of production it was logical to look for a downward readjustment of sales prices. The rapid rise of supply over demand, however, encouraged selling pressure which carried prices down below the producing cost of some manufacturers. The situation became more complicated in the latter part of the year when producers sought to work off surplus stocks and to book orders for 1927 delivery.

While the open quotation for aqua ammonia 26 deg. was given as 3c. per lb., this price was shaded materially on actual business and the same held true of anhydrous which was quoted at 11c. per lb.

No official figures are available covering production of aqua and anhydrous ammonia during the year but it is probable that the output exceeded that for 1925 and that surplus stocks were large at the close of the period. The census figures for 1925 reported a total of 66,227,955 lb. of aqua ammonia offered for sale as compared with 38,694,140 lb. in 1923. This indicates in supply of more than 70 per cent in the two-year period and with a still larger output in 1926 it is easily possible to visualize the growing discrepancy between supply and demand. The amount of anhydrous ammonia for sale in 1925 was 31,724,858 lb. which compares with 23,529,362 lb. in 1923.

In the figures as given by the Census Bureau, there is wide discrepancy between those for total production and those for sale, the latter being much smaller and therefore showing that considerable amounts of ammonia are consumed at producing plants.

Sharp Rise in Manufacture of Ethyl Alcohol

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1925, the establishments engaged primarily in the manufacture of ethyl alcohol, mainly from molasses and grain, and related products, such as denatured rum, reported the production of ethyl alcohol to the value of $55,925,027, and of other products to the value of $1,780,677, making a total value of $57,705,704, an increase of 74.9 per cent as compared with $33,000,099 for 1923, the last preceding census year.

In addition, ethyl alcohol was manufactured to some extent by establishments engaged primarily in other industries. The value of this commodity thus produced outside the industry proper in 1923 was $1,132,802, an amount equal to 3.4 per cent of the total value of products reported for the industry as classified. The corresponding value for 1925 has not yet been calculated but will be shown in the final report of the present census.

Lower Selling Prices for Lead Pigments

Trading in white lead and the other lead pigments was featured by the establishment of lower price levels. The downward trend to values was more prominent in the latter part of the year. The decline in values was a logical result of developments in the market for the metal. Importations of pig lead, mainly from Mexico, will total about 75,000 tons for the year as compared with 15,000 tons in 1925. This increase in imports explains the lower prices which ruled in the metal market and which in turn cut down the cost of producing the pigments. The permanence of the lower prices is expected to depend on the activity of European buyers. Should the latter come into the market in a normal way in 1927, it is probable that importations of pig lead into this country will be curtailed with a strengthening of prices for the metal and for the pigments.

Domestic consumption of white lead was of large proportions with very little difference reported as compared with that for the preceding year. Export business fell away from the total of 1925. Exports for the last 6 years were as follows:

	Lb.		Lb.
1926*	11,872,215	1923	10,344,089
1925	13,663,309	1922	8,945,730
1924	10,109,455	1921	17,408,803

* Eleven months ended November.

	High	Low		High	Low
1926	$0.10¾	$0.09¾	$923	$0.09¾	$0.08¼
1925	.11	.10¼	1922	.08¾	.06¼
1924	.11	.09¼	1921	.10½	.08¾

The high and low prices for round lots of dry basic carbonate of lead in the New York market compare as follows:

Total sales of lead pigments in 1925, as reported to the Bureau of Mines by producers, were slightly less than in 1924; sales of the individual pigments, however, were greater, with the exception of those of white lead ground in oil which decreased 17 per cent.

The average selling value of each pigment showed a substantial increase. The value of white lead, dry, is based on the average selling value of the domestic shipments although some export shipments were made at a lower price owing to the drawback allowance of the duty paid on the foreign material used in their manufacture.

SALES OF LEAD PIGMENTS

	1924			1925		
	Short Tons	Value Total	Value Per Ton	Short Tons	Value Total	Value Per Ton
Sublimed lead: (a)						
White	14,572	$2,391,038	$164	14,996	$2,692,060	$180
Blue	1,088	178,899	164	1,090	210,933	194
Red lead	36,813	7,707,264	209	41,669	9,445,527	227
Orange mineral	331	89,825	271	840	237,408	283
Litharge	74,724	14,597,434	195	86,546	18,587,399	215
White lead:						
Dry	42,622	7,900,519	185	43,426	8,622,977	199
In oil	144,872	35,003,984	242	120,479	31,352,776	260

(a) Includes basic sulphate lead

Active Call Reported for Cream of Tartar

Although the major part of demand came from the food and medicinal industries, chemical manufacturers participated in the increased consumption which was reported for cream of tartar in the last year. Official figures are lacking to show the output of manufacturing establishments but reports of a larger production are borne out by the more active position of consuming trades during the year. The census figures give domestic as follows for 1925 and 1923:

	No. of Establishments	Production Lb.	Value
1925	4	7,041,766	$1,465,305
1923	4	5,971,186	1,746,363

The domestic material was forced to meet competition from foreign makers and prices were held on a fairly steady basis ranging from 21c. to 23c. per lb., with imported offerings generally a little under the prices asked for domestic goods.

Foreign Sellers Less Active in Prussiate Market

In 1925 imports of yellow prussiate of potash were only 238,643 lb. and arrivals from abroad were shown to be declining each year. No official figures for imports in 1926 are yet available but competition from importers was not keen during the year. In the first 11 months of 1926 imports of prussiate of soda amounted to 759,013 lb. as against 1,376,544 lb. in the corresponding period of 1925. In the latter part of last year some importers reported difficulty in securing workable quotations on prussiates for shipment to this country and the market seemed to be entirely dominated by the domestic product.

Prices for both the soda and potash products were firmly maintained during the year with only fractional variations between the high and low price levels.

Competition Weakens Prices for Borax

Buyers of borax have been favored in the past two years by the keenness with which producers were competing for business. According to reports the producing costs at different mines show considerable variation and those who are able to produce cheaply are leading the way in bringing values to lower levels. There also is said to have been a readjustment in the proportionate amount which different producers can turn out and the increase in offerings which have come to certain producers has made them more important factors in the industry. Outside of the easier tone to prices the market has gone along in a routine way with a normal call for deliveries for domestic account. Export buying was less active than in 1925 and total shipments to foreign markets for the 11 months ended November were 26,746,194 lb., valued at $1,171,337 in comparison with 30,941,658 lb., valued at $1,380,058 in the corresponding period of 1925.

Sulphuric and Nitric Acid Production in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, the establishments engaged primarily in the manufacture of sulphuric, nitric, and mixed sulphuric-nitric acids reported, for 1925, such products for sale to the value of $18,154,684, together with miscellaneous products, chiefly chemicals other than sulphuric, nitric, and mixed acids, valued at $5,152,329, making a total of $23,307,013.

Of the 36 establishments reporting for 1925, 5 were located in Pennsylvania, 4 in California, 4 in New Jersey, 4 in Ohio, 3 in New York, 3 in Texas, 2 in Arkansas, 1 in Alabama, 1 in Colorado, 1 in Connecticut, 1 in Illinois, 1 in Kansas, 1 in Louisiana, 1 in Oaklahoma, 1 in Tennessee, 1 in Utah, 1 in Virginia, and 1 in Wisconsin. In 1923 the industry was represented by 37 establishments, the decrease to 36 in 1925 being the net result of a loss of 5 establishments and a gain of 4. Of the 5 establishments lost to the industry, 3 reported products other than sulphuric, nitric, and mixed acids as their principal products and were therefore transferred to the proper industries, 1 was idle throughout the year, and 1 had gone out of business prior to the beginning of 1925.

Summary statistic for products by kind, quantity, and value in Table I. The figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

PRODUCTION OF SULPHURIC AND NITRIC ACIDS IN 1925

Products by Kind, Quantity and Value: 1925 and 1923

		1925	1923
Total value		$50,808,994	$52,219,208
Sulphuric, nitric and mixed acids industry (all products)		$23,307,013	$24,404,580
Subsidiary products of other industries		$27,501,981	$27,814,628
Sulphuric Acid			
Number of establishments		178	185
Total production (basis 50° Baume)	tons	7,012,328	6,555,517
For sale	tons	4,697,116	4,344,698
	value	$38,330,274	$38,274,540
Made and consumed	tons	2,315,212	2,210,819
Production by industries:			
Sulphuric, nitric and mixed acids	tons	2,161,034	2,049,293
Chemicals not elsewhere classified	tons	1,857,535	1,926,142
Fertilizer	tons	1,979,292	1,631,217
Explosives	tons	162,055	146,938
Other industries (petroleum refining, zinc and copper smelting, etc.)	tons	852,412	801,927
Production according to strength:			
50° Baume	tons	2,165,672	1,564,066
For sale	tons	723,925	259,812
	value	$5,530,601	$2,150,439
Made and consumed	tons	1,441,747	1,304,254
60° Baume	tons	1,202,042	1,512,816
For sale	tons	970,750	1,204,720
	value	$7,609,027	$9,890,933
Made and consumed	tons	231,292	308,096
66° Baume	tons	966,647	800,631
For sale	tons	787,826	674,148
	value	$10,316,880	$10,097,967
Made and consumed	tons	178,821	126,483
Oleum, trioxide, etc	tons	1,161,370	1,164,889
For sale	tons	967,525	961,355
	value	$14,873,766	$16,135,202
Made and consumed	tons	193,845	203,534
Nitric Acid			
Number of establishments		53	55
Production	tons	119,652	113,116
For sale	tons	26,852	21,759
	value	$3,559,695	$2,741,370
Made and consumed	tons	92,800	91,357
Production according to strength:			
36° Baume	tons	2,012	4,928
38° Baume	tons	6,515	10,758
40° Baume	tons	92,632	74,682
100 per cent	tons	17,677	21,948
C. P.	tons	816	800
Total production, basis 100 per cent	tons	79,880	77,633
Mixed Acid (Sulphuric-Nitric)			
Number of establishments		39	51
Production	tons	160,377	156,467
For sale	tons	61,290	77,933
	value	$3,766,696	$5,502,735
Made and consumed	tons	99,087	78,534
All other products (chiefly chemicals other than sulphuric, nitric, and mixed acids)	value	$5,152,329	$5,700,563

Bichromate of Potash Holds Unchanged Course

The majority of consumers of bichromates continue to give the preference to the soda compound and there is little probability of a large increase in the demand for bichromate of potash. For certain uses in the leather, color, and laboratory trades, the potash salt still holds its place but the large users show but little interest in it. Total production is said to be about 3,000 tons a year or one-third of what it was a few years ago. Export demand fell away sharply last year the figures for the 11 months ended November, being 116,141 lb., valued at $9,411 which compares with 420,603 lb., valued at $32,364. The price movement in bichromate of potash also was not important as quotations were kept on an even keel with the usual consideration shown to buyers of round lots.

Price Fluctuations in Cottonseed Oil

The past year in the cottonseed oil industry was noted for the wide fluctuations in values which prevailed at different times of the year. The market for both refined and crude oil in January was firm but as the months advanced values gradually increased. The stronger position of values resulted from substantial gains in monthly consumption of oil and the dwindling of visible supplies. As consuming demand gained ground toward the latter part of the crop year, the possibility of a scarcity of oil loomed up and values moved upward at a rapid rate until P.S.Y. oil had crossed the 16c. per lb. level. Then came a reversal in the situation when the government reported that a cotton crop of record proportions was in the making. As reports

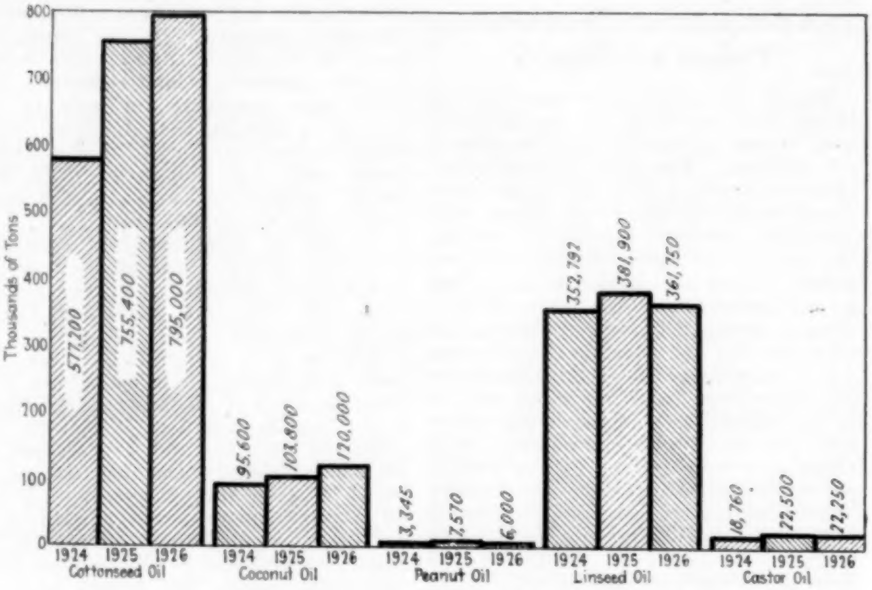
CONSUMPTION OF COTTONSEED OIL

	1924–1925 Bbl.	1925–1926 Bbl.
August	157,000	254,000
September	157,000	321,000
October	328,000	395,000
November	281,000	375,000
December	238,000	309,000
January	262,000	369,000
February	228,000	266,000
March	293,000	282,000
April	193,000	288,000
May	278,000	206,000
June	302,000	261,000
July	302,000	158,000
Total	3,019,000	3,484,000

of a very large cotton crop continued to reach the market and preponderance of cottonseed oil seemed to be assured for the new crop year, demand for old crop oil fell off and buying took on a hand to mouth character. Selling pressure then appeared as no one cared to carry over high priced oil into a year when low prices appeared to be a certainty. Speculative selling also added its weight to the bearish movement and values for P.S.Y. oil declined below 8c. per lb. A moderate recovery in values set in later in the year with some encouragement given by large monthly distributions and prospects for a better outlet for oil in foreign markets.

Outside of the irregularity of prices the most noteworthy feature of the year was the increased demand for oil on the part of domestic consuming industries. It is apparent that there has been a rapid increase in what may be termed the normal consuming requirements of the country which of course may vary according to the selling prices. The accompanying table gives the monthly disappearance of cottonseed oil for the 1925-1926 crop year together with comparisons for the preceding crop year.

It will be noted from the figures of disappearance that consumption of cottonseed oil increased more than 15 per cent in the crop year. For the first four months of the 1926-1927 crop year the disappearance of oil was 1,142,000 bbl. which compares with 923,000 bbl. in the corresponding period of the preceding year. Hence the demand for oil is still increasing and probably will continue to do if prices hold anywhere near current levels. While the cotton crop was undoubtedly the largest on record a large part of it has not been harvested and the possibility is present of large amounts of seed which will run high in moisture with a consequent high loss in refining the oil. This means that production of refined oil in the 1926-1927 season may not increase in proportion to the increase in the cotton crop.



DOMESTIC PRODUCTION OF LEADING VEGETABLE OILS

Production of Linseed Oil Falls Off

According to a report from the Bureau of Census, production of linseed oil in this country in 1925, amounted to 763,822,379 lb. with stocks on Dec. 31, 1925, amounting to 155,846,898 lb. On the same authority production of this oil for the 9-month period ended September, 1926, was 513,992,546 lb. and stocks on Sept. 30 were 107,212,865 lb. In the last quarter of 1925 production was placed at 217,992,134 lb. In the last quarter of 1926 production was probably slightly under that for the last quarter of 1925 as one mill did not operate in the former period. Total production therefore was smaller in 1926 than in 1925. The reduction in stocks, however, would go far to make up for the falling off in production and total disappearance of oil would show but little difference in the two years.

The trend of prices for linseed oil during the year was downward. The chief factor contributing to the decline was the record supply of flaxseed which had been produced in the Argentine and its effect in lowering values for seed in all consuming markets. The practice which had been established in the preceding year of quoting oil on a lb. instead of on a gal. was adhered to. At the beginning of the year oil in carlots was held at 12.9c. per lb. and at the close of the year buyers could place orders at 10.6c. per lb. so that a materially lower price level had been reached during the year.

A flaxseed crop of 18,779,000 bushels for 1926 was indicated by condition of the crop on Nov. 1, the Crop Reporting Board estimated. This is about three and a quarter million bushels smaller than the actual harvest in 1925. In the more important producing States unfavorable conditions throughout the season resulted in yields per acre below the usual average, the report says, while dockage has been relatively high and as a result of early frosts and weather damage the average quality of the flax crop is the lowest in fifteen years.

Following are the details in the principal producing States:

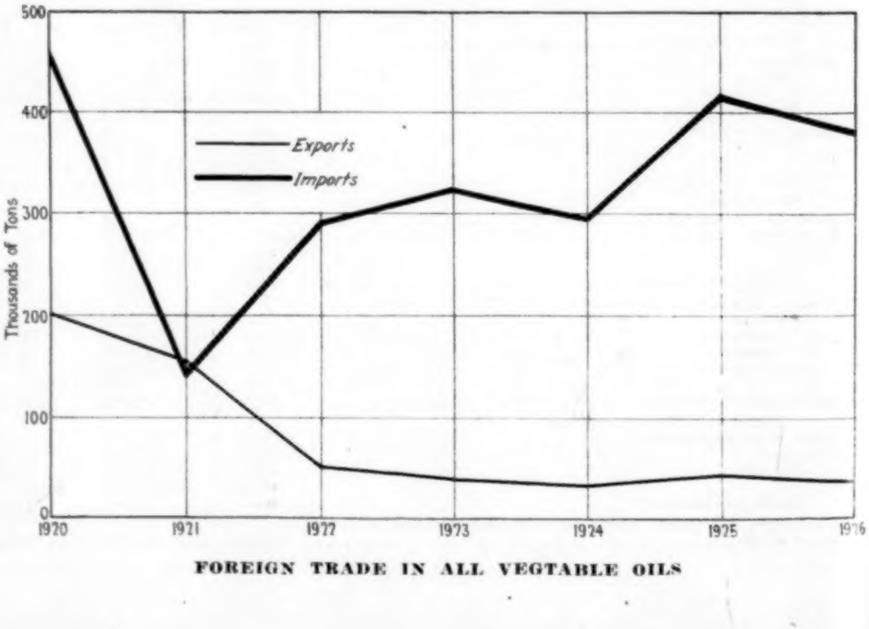
Acreage in other flaxseed producing countries show the following:

FLAXSEED ACREAGE IN FOREIGN COUNTRIES

	Acres: Average 1909–13	1924	1925	Preliminary 1926
Three countries previously reporting and unchanged*	†2,489,800	3,519,554	3,065,900	2,897,100
Canada, revised	1,034,874	1,276,667	1,128,100	817,000
Argentina, revised	4,113,434	5,379,345	‡6,201,100	‡6,672,000
Uruguay	126,528	146,000	185,100	187,800
Total six countries	†7,764,636	10,321,566	10,580,200	10,573,900

FLAXSEED ACREAGE BY STATES

	Total Prod., Thousands of Bus.: 1926 Preliminary Nov.	1925	Five-Year Average 1921–25	Yield per Acre: 1926 Prelim. Nov. Bus.	Ten-Year Av. Bus.	Quality: 1926 Pct.	Ten-Year Av. Pct.
Minnesota	7,858	7,600	5,414	9.4	9.7	85	91
North Dakota	6,864	8,768	8,083	5.3	7.0	86	90
South Dakota	2,593	3,801	2,807	5.8	8.3	85	91
Montana	798	1,220	1,083	4.2	5.3	88	89
United States total	18,779	22,018	17,839	6.6	7.4	85.6	90.6



FOREIGN TRADE IN ALL VEGTABLE OILS

Stocks of China Wood Oil Drawn Upon

Owing to conditions in China which interfered with the movement of wood oil from interior points to shipping terminals, a small movement of this oil to this country marked trading in 1926. It is also probable that the higher price levels which prevailed at periods during the year contributed to the decline in buying orders from this country. The smaller receipts from abroad, however, do not necessarily mean that domestic consumption fell away from that of the preceding year. The Department of Commerce in census of oils reports that consumption of wood oil for the first 9 months of 1926 reached a total of 64,202,408 lb. which exceeded the total of 63,915,530 lb. for the corresponding period of 1925. Total consumption in 1925 was placed at 87,881,315 lb. With a fairly normal consumption in the last quarter of 1926 the total for that year would compare favorably with that for 1925. Imports for the 11 months ended November were 75,430,785 lb. in 1926 and 92,947,034 lb. in 1925. From the above figure it is evident that domestic consumption last year was larger than the importations. The deficit in supplies, thus indicated, was made by a decrease in the stocks carried in this country. On Jan. 1, 1926, such stocks were reported at 32,943,278 lb. whereas on Sept. 30 they had been cut down to 17,206,063 lb. There have been reports that domestic consumption of wood oil had been adversely affected by the growing use of pyroxylin lacquers but this is not borne out by statistics as consumption of the oil was larger in 1926 and 1925 than it was in 1924.

Prices for wood oil showed a tendency to be influenced by quotations for shipments from primary points as holders of oil in this country did not care to sell under replacement costs. The range for oil in bbl. at New York ranged from 12c. per lb. to 18c. per lb.

More Fertilizer for Cotton Belt Last Year

The application of fertilizer over a larger cotton area this year resulted in the use of a total of 2,444,000 tons on cotton alone compared with 2,307,000 tons last year, although less fertilizer was used per acre in 11 states, according to reports to the United States Department of Agriculture. About 1,800,000 tons, or nearly 75 per cent of the total, was used in North Carolina, South Carolina, Georgia and Alabama.

The average price paid for the fertilizer in the 11 states was $32.59 a ton with an aggregate of $79,639,000, compared with $32,39 a ton and an aggregate of $74,707,000 last year. The average cost of fertilizer per acre of cotton this year was $4.36 for an average of 268 lb.

Sales of fertilizer for all purposes in 11 cotton states for the year ended approximately in June, 1926, based on sales of tags, totaled approximately 4,883,000 tons compared with 4,697,000 tons in 1925.

Production of Lime Gained in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, the establishments engaged primarily in the production of lime reported, for 1925, a total output valued at $50,651,748, an increase of 7.2 per cent as compared with $47,243,756 for 1923, the last preceding census year. Of the total for 1925, $26,310,529 was contributed by quicklime, $15,539,371, by hydrated lime, $4,724,653 by limestone sold as such, and $4,077,195 by other products.

Frequent Price Changes in Tin Salts

The course of the metal market was closely followed by sellers of tin salts. Average monthly prices for tin were taken as a basis for establishing quotations for the salts and the quotations held good for delivery throughout the month for which they were named. In the case of tin oxide there was, at times, a difference in price according to seller with some reports crediting the range to a difference in quality. In the latter part of the year a departure was made from the old method of quoting on a monthly basis and price changes then became more frequent depending on fluctuations in the tin market. Net changes in tin crystals, tin oxide, and bichloride of tin were in favor of higher prices.

Large Gain in Petroleum Refining in 1925

The Department of Commerce announces that according to data collected at the biennial census of manufacturers taken in 1926, the establishments engaged primarily in petroleum refining reported, for 1925, a total output valued at $2,373,178,014, representing increases of 32.3 per cent as compared with $1,793,700,087 for 1923, 37.4 per cent as compared with $1,727,440,157 for 1921, and 45.4 per cent as compared with $1,632,532,766 for 1919.

The production of gasoline increased from 7,332,329,194 gal. in 1923, valued at $876,732,346, to 10,702 877,654 gal. in 1925, valued at $1,215,897,264. These figures refer only to the gasoline produced by petroleum refineries. In addition, the Bureau of Mines reports the following production of "casing-head" natural-gas gasoline: For 1925, 1,104,900,000 gal., valued at $117,000,000; for 1923, 816,226,000 gal., valued at $77,268,000. The production of fuel oil increased from 11,976,396,147 gal., valued at $345,666,436 in 1923, to 14,578,766,056 gal., valued at $488,263,429, in 1925; and the output of lubricating oils increased during the same period from 1,150,653,387 gal., valued at $204,494,849, to 1,356,971,112 gal., valued at $251,497,008.

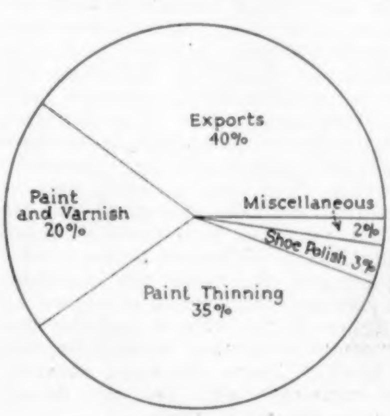
Among the detailed statistics which were given in the report were the following:

	Year	Quantity Gal.	Value
Light products of distillation:			
Gasoline *a*	1925	10,702,877,654	$1,215,897,264
	1923	7,332,329,194	876,732,346
Naphtha	1925	294,946,777	29,938,400
	1923	399,492,628	38,761,417
Benzine	1925	41,714,476	4,992,842
	1923	67,732,920	8,862,591
Tops	1925	215,947,696	12,117,350
	1923	(*b*)	(*b*)
Other	1925	32,173,529	3,363,624
	1923	50,967,751	5,543,724
Paraffin wax	1925	89,557,164	30,510,343
	1923	69,536,104	12,899,125
Residuum or tar	1925	131,170,898	5,964,368
	1923	80,066,120	3,190,668
		Short Tons	
Asphalt other than liquid asphalt	1925	3,593,883	30,460,927
	1923	2,113,573	23,338,914

a Not including "casing head" (natural gas gasoline). The production of such gasoline is reported by the Bureau of Mines as follows: 1925, 1,104,900,000 gallons, valued at $117,000,000; 1923, 816,226,000 gallons, valued at $77,268,000.

b Not reported as such for 1923. Included in some cases under "Gasoline" and in other cases under partly refined oil.

Distribution of Rosin



Distribution of Turpentine

Naval Stores Statistics for 1925

According to figures compiled by the Bureau of Chemistry, industrial concerns using turpentine and rosin in their products consumed during the calendar year 1925 a total of 7,174,115 gal. of turpentine and 1,004,304 bbl. of rosin, together with 49,790,087 gal. of mineral oil thinners. The distribution of these data by industries for 1925 and 1924 is shown in Table I.

By including certain statistics on production compiled and published by non-governmental agencies, together with foreign trade statistics furnished by the Bureau of Foreign and Domestic Commerce, the Bureau of Chemistry is able to present a complete report on production, industrial consumption, exports and stocks of turpentine and rosin for the season 1925-1926, ending March 31, 1926. Similar data for preceding years are included for comparison.

The production of gum turpentine and gum rosin for the past two seasons, as published by the Turpentine and Rosin Producers Association, was distributed by States as shown in Table II.

In addition to gum turpentine and gum rosin, which are produced from the oleoresin obtained from the living tree, considerable quantities of wood turpentine, wood rosin and pine oil are produced from resinous wood by the steam-solvent and the destructive distillation industries. The total production of all three classes during the past two seasons is set forth in detail in Table III.

Stocks of turpentine and rosin held throughout the country on March 31, the closing day of the naval stores season, for the past three seasons, as compiled by the Bureau of Chemistry, are found in Table IV.

Our foreign trade in turpentine and rosin for the past three years is shown by the figures in Table V.

In Table VI the data given in the preceding tables have been grouped together by seasons in order to more clearly show the trend of the situation in this country as regards naval stores production, consumption, and supplies.

From the data on turpentine shown in Table VI it is possible to arrive at a rough approximation of the quantity of turpentine used in this country by painters for thinning paint and varnish prior to applying same, and for the many and varied household purposes. This quantity is in the neighborhood of 10,000,000 gal. annually. This is obtained by deducting the totals for exports, industrial consumption, and remaining stocks from total supplies. Rosin, however, is practically all consumed in industrial manufacturing processes. The total quantity used by individuals or firms in a small way for various purposes is relatively unimportant. The difference between total supplies and the totals for consumption, exports, and stocks, as shown by the figures in the table, is probably due to incomplete figures on consumption and stocks. These are being obtained more completely each year but do not yet cover the entire trade.

TABLE I—INDUSTRIAL CONSUMPTION OF TURPENTINE AND ROSIN DURING 1925 AND 1924

	1925*			1924		
Industry	Turpentine Gal.	Rosin Bbl.	Mineral Spirits Gal.	Turpentine Gal.	Rosin Bbl.	Mineral Spirits Gal.
Paper and paper size	5,874	313,365	....	11,764	275,353	....
Soap	3,540	281,230	72,448	22,188	209,912	57,088
Paint and varnish	5,705,414	228,207	49,079,087	5,365,178	219,241	42,344,352
Shoe polish	824,463	338	2,841	801,453	209	6,000
Printing ink	10,879	14,195	18,986	12,860	8,487	3.528
Oils and greases	124,785	53,616	71,652	145,612	51,880	7,008
Sealing wax, pitch, insulations and plastics	61,058	46,564	240,954	51,307	44,196	801,751
Matches	226	2,807	....	5	2,993	....
Linoleum	4,165	37,747	115,986	17	29,490	140,370
Chemicals and pharmaceuticals	77,041	2,988	....	11,788	1,867	....
Automobiles and wagons	276,570	360	117,490	259,633	1,525	73,822
Iron, steel and brass	22,024	20,748	31,958	19,352	19,572	7,186
Shipyards	15,750	76	21,810	19,027	113	18,010
Miscellaneous	42,326	2,063	16,875	19,437	3	1,000
Total	7,174,115	1,004,304	49,790,087	6,739,621	864,841	43,460,115

*Consumption data are obtainable only for the calendar year, whereas all other data n the report, with the exception of import figures, are for the fiscal year of the naval stores industry.

TABLE II—PRODUCTION BY STATES

	1925–1926			1924–1925		
	Production			Production		
	Turpentine 50 Gal. Casks	Rosin 500 Lb. Bbl.	No. Corps Worked	Turpentine 50 Gal. Casks	Rosin 500 Lb. Bbl.	No. Corps Worked
Alabama	31,114	102,775	931.8	36,744	121,255	1,182.8
Florida	172,981	570,837	5,562.7	183,109	604,260	6,170.8
Georgia	206,035	679,915	5,796.6	198,640	655,512	5,733.5
West La. & Texas	17,976	59,320	334.3	44,926	148,256	733.0
East La. & Miss	40,309	133,019	683.0	49,025	161,782	791.3
North & S. Carolina	10,000	33,000	355.0	9,000	29,700	320.0
	478,445	1,578,866	13,663.4	521,444	1,720,765	14,931.4

Rosin figures not given in published reports. Calculated from turpentine figures by using factor 3.3

TABLE III—TOTAL PRODUCTION

	1925–1926			1924–1925		
	Turpentine, Gal.	Rosin, Bbl.	Pine Oil Gal.	Turpentine, Gal.	Rosin Bbl.	Pine Oil Gal.
Gum products	23,922 250	1,578,866	....	26,072,200	1,720,765	....
Steam solvent products	2,932,119	284,504	1,862,899	2,851,250	257,531	1,630,748
Destructively distilled products	407,056	....	86,450	410,000	....	85,200
Estimated reclaimed from dross	....	40,000	....	....	40,000	....
	27,261,425	1,903,370	1,949,349	29,333,450	2,018,296	1,715,948

TABLE IV—STOCKS ON HAND AND ENROUTE AS OF MARCH 31

	Turpentine Gal.			Rosin Round (500 lb.) Barrels		
Stocks held at	1926	1925	1924	1926	1925	1924
Gum turpentine stills	378,400	457,550	1,122,050	92,245	150,045	345,214
Steam distillation plants	142,847	681,236	367,930	22,616	45,462	37,599
Destructive distillation plants	91,097	65,000	107,070	222	....	....
Southern primary ports	1,576,550	1,579,500	1,499,100	148,049	225,188	307,543
Eastern ports and distributing points	235,500	143,000	181,950	3,801	8,134	14,060
Central ports and distributing points	685,050	602,200	711,600	11,132	19,435	28,881
Western ports and distributing points	94,500	237,100	412,300	613	2,188	1,492
Plants of consuming industries	848,890	1,265,018	934,581	165,543	195,636	264,558
	4,052,834	5,030,604	5,326,581	444,221	646,088	999,347

TABLE V—FOREIGN TRADE

Season		Turpentine Gal.	Rosin Round bbl.
1925–1926	Exports	11,361,500	1,083,131
	Imports	287,379	17,068
1924–1925	Exports	12,485,150	1,463,168
	Imports	177,675	1,574
1923–1924	Exports	11,228,400	1,170,160
	Imports	156,397	2,358

Note: Imports are for Government fiscal years, ending June 30.

TABLE VI—TOTAL SUPPLIES AND DISTRIBUTION

	1923–24		1924–25		1925–26	
	Turpentine Gal.	Rosin Bbl.	Turpentine Gal.	Rosin Bbl.	Turpentine Gal.	Rosin Bbl.
Stocks at close of previous season	3,582,800	1,132,505	5,326,581	899,347	5,030,604	646,088
Production	29,781,944	1,991,787	29,333,450	2,018,296	27,261,425	1,903,370
Imports	156,397	2,358	177,675	1,574	287,379	17,068
Total supplies	33,521,141	3,126,650	34,837,706	3,019,217	32,579,408	2,566,526
Exports	11,228,400	1,170,160	12,485,150	1,463,168	11,361,500	1,083,131
Industrial consumption	6,704,952	902,010	6,739,621	864,841	7,174,115	1,004,304
Stocks at close of current season	5,326,581	999,347	5,030,604	646,088	4,052,834	444,221

Stocks include those on hand at plants of consumers.

Foreign Trade in Chemical Products

Exports of Chemicals and Allied Products

		12 Months Ended December				11 Months Ended November	
		1924		1925		1926	
		Quantity	Value	Quantity	Value	Quantity	Value
Animal oils							
Oleo oil	Lb.	99,379,879	$14,113,338	91,790,845	$11,814,197	89,813,262	$11,044,156
Neatsfoot oil	Lb.	1,824,023	276,981	1,431,399	253,117	998,741	182,357
Other animal oils	Lb.	1,874,001	229,796	2,146,601	281,146	564,726	69,291
Fish oils	Lb.	778,273	119,294	614,274	115,078	637,786	104,800
Oleo stock	Lb.	13,797,405	1,711,311	12,174,166	1,527,944	11,606,902	1,370,128
Tallow	Lb.	33,961,656	2,899,302	17,514,444	1,624,093	9,617,180	864,138
Lard	Lb.	944,095,014	125,728,262	688,828,950	118,089,981	636,280,756	99,903,378
Lard compounds	Lb.	7,381,985	1,023,303	14,090,716	2,041,215	9,322,332	1,329,207
Stearin and fatty acids							
Oleo and lard stearin	Lb.	6,575,373	752,705	7,394,780	960,742	6,911,294	833,981
Grease stearin	Lb.	3,007,865	303,112	2,631,160	295,845	2,250,183	252,181
Oleic acid or red oil	Lb.	2,689,146	226,123	490,773	51,471	814,968	82,313
Stearic acid	Lb.	1,908,560	230,923	1,929,374	282,459	819,030	114,588
Oleomargarine, animal	Lb.	774,302	126,244	626,701	109,953	1,490,955	203,130
Other animal greases, oils, fats	Lb.	79,683,961	7,353,898	81,264,163	9,393,772	64,794,779	6,236,657
Glue, animal origin	Lb.	2,172,858	348,376	2,545,783	384,540	2,274,303	357,828
Wax manufactures	Lb.	1,586,435	331,308	1,861,954	317,290	2,465,412	422,853
Oil cake and meal							
Cottonseed cake	Lb.	410,991,534	8,673,425	561,446,037	11,571,397	439,907,304	7,424,503
Linseed cake	Lb.	632,560,692	13,654,881	638,532,208	14,238,001	528,350,254	11,172,630
Other oil cake	Lb.	3,375,377	67,572	17,697,659	272,904	14,299,699	211,593
Cottonseed meal	Lb.	210,773,675	4,496,614	237,522,841	4,938,391	217,470,438	3,694,812
Linseed meal	Lb.	20,993,940	445,631	12,159,124	283,779	12,801,902	271,516
Other oil meal	Lb.	11,252,595	251,667	20,398,324	361,330	1,791,110	33,761
Oil seeds	Lb.	3,267,596	221,686	3,685,747	278,664	2,401,706	164,173
Vegetable oils, expressed and fats							
Linseed oil	Lb.	2,386,685	317,995	2,487,134	355,480	2,413,129	233,195
Soya bean oil	Lb.	2,264,195	252,571	519,668	43,579	1,308,626	156,446
Coconut oil	Lb.	17,960,589	1,603,695	17,901,213	1,763,741	14,741,040	1,433,945
Cottonseed oil, crude	Lb.	18,948,410	1,718,519	33,553,552	3,035,930	24,278,919	2,255,818
Cottonseed oil, refined	Lb.	24,394,107	2,867,916	28,861,920	3,480,970	9,921,853	1,240,452
Corn oil	Lb.	3,678,608	495,777	3,847,330	517,919	1,315,770	189,347
Vegetable soap stock	Lb.	5,528,330	299,590	7,750,925	498,882	11,658,262	643,801
Other vegetable oils and fats	Lb.	5,467,950	702,917	8,536,776	941,597	6,414,685	918,067
Naval stores							
Rosin	Bbl.	1,452,387	13,754,790	1,172,335	18,888,525	984,553	22,273,157
Spirits of turpentine	Gal.	11,510,154	10,105,015	11,557,221	11,346,464	9,988,429	9,253,211
Wood turpentine	Gal.	561,446	443,340	583,605	439,275	629,770	484,996
Tar and pitch, wood	Bbl.	51,241	266,786	25,044	202,490	22,353	197,755
Other gums and resins	Lb.	2,139,541	739,203	2,807,124	933,438	2,890,295	793,411
Dye extracts							
Logwood extract	Lb.	1,483,954	189,052	2,225,358	251,640	1,755,202	192,379
Other dye extracts	Lb.	1,689,655	221,985	1,396,167	150,993	596,858	129,982
Dyeing and tanning							
Materials, crude	Ton	2,206	92,921	8,011	141,477	1,198	56,140
Tanning extracts							
Chestnut	Lb.	9,275,657	290,728	7,286,552	216,644	5,482,898	156,771
Other tanning extracts	Lb.	22,546,421	1,137,888	21,515,249	1,178,447	22,073,043	1,120,603
Starch							
Cornstarch	Lb.	265,151,419	8,522,143	222,267,247	7,977,655	181,530,635	5,552,406
Other	Lb.	5,231 607	221,017	10,482,103	378,550	17,779,189	514,225
Mineral oils							
Petroleum, crude	Gal.	739,404,849	26,495,011	551,246,432	24,274,447	593,168,892	26,206,630
Petroleum, refined	Gal.	3,922,268,229	391,987,434	3,938,131,052	421,227,283	4,161,908,506	456,460,358
Mineral spirits	Gal.	987,825	344,824	1,055,453	309,046	1,643,755	362,009
Gas and fuel oil	Gal.	1,440,281,923	49,352,598	1,368,003,714	49,044,756	1,310,763,210	40,818,428
Paraffin wax							
Unrefined	Lb.	92,632,299	4,109,237	71,889,026	3,843,973	63,136,078	3,262,588
Refined	Lb.	290,187,716	14,415,903	261,720,588	14,751,776	243,636,880	14,042,417
Petroleum asphalt	Ton			79,477	1,762,048	119,289	2,910,639
Lime	Bbl.	149,053	212,340	147,995	218,696	121,136	176,729
Sulphur	Ton	482,114	7,792,854	629,401	11,000,235	531,665	10,018,639
Salt	Lb.	289,889,103	1,288,376	310,158,759	1,219,935	283,917,970	1,184,274
Plate and window glass							
Window glass	Box	41,536	186,986	25,131	143,313	28,791	167,105
Plate, unsilvered	Sq.Ft.	1,809,300	516,163	1,578,657	407,440	818,896	230,911
Other	Lb.	2,105,976	221,268	2,447,333	272,891	2,670,049	246,772
Chemical glassware	Lb.	238,195	190,666	226,798	196,790	207,657	188,944
Ferro-alloying ores and metals							
Ferromanganese and spiegeleisen	Ton	3,165	92,421	5,496	160,568	643	39,998
Ferrotungsten, etc	Lb.	4,578	114,775	13,238	143,987	26,308	141,514
Other	Lb.	6,081,910	191,340	3,543,423	253,124	5,663,309	567,842
Printers ink	Lb.	10,415,983	1,279,209	11,303,849	1,330,329	10,004,474	1,333,605
Paste and mucilage	Lb.	2,506,602	283,322	3,500,503	399,373	3,223,897	358,356
Candles	Lb.	1,384,817	224,161	1,383,936	251,618	1,135,155	230,227
Rubber			39,641,017		51,343,898		54,278,385
Magnesia and manufactures	Lb.	3,120,070	243,579	5,264,203	316,978	5,903,914	283,377
Chemicals and related products							
Coal-tar products							
Crudes							
Benzol	Lb.	57,882,171	1,739,837	58,890,162	1,748,034	120,852,790	4,633,597
Crude tar and pitch	Bbl.	269,015	1,076,203	108,795	326,925	108,937	430,349
Other crudes	Lb.	14,505,160	454,386	20,498,923	640,597	24,001,733	624,726
Intermediates							
Aniline oil and salt	Lb.	375,459	101,437	803,731	153,622	307,304	52,048
Other	Lb.	1,720,989	261,646	1,727,467	317,522	1,215,401	253,377
Finished products							
Coal-tar colors, dyes, etc	Lb.	15,713,091	5,635,064	25,799,889	6,694,360	23,707,572	5,503,081
Medicinals	Lb.	288,405	321,766	728,090	447,143	615,704	342,615
Photographic chemicals	Lb.	173,995	80,751	314,491	95,449	408,272	121,965
Other	Lb.	2,147,368	304,962	3,102,637	337,250	1,256,181	217,510
Medicinal and pharmaceutical preparations							
Quinine sulphate and other cinchona salts	Oz.	321,490	168,103	688,024	237,331	262,463	131,158
Antitoxins, serums, and vaccines			1,054,870		1,248,874		1,322,723
Other			15,600,958		17,636,761		16,001,098
Crude drugs, dyeing and tanning materials			7,647,613		6,573,481		9,347,649
Drugs, herbs, leaves, roots							
Ginseng	Lb.	167,318	2,399,926	138,131	1,668,221	132,084	1,933,690
Other	Lb.	7,722,346	1,640,183	5,742,695	1,292,892	4,584,270	867,334
Essential oils							
Peppermint	Lb.	176,820	846,528	68,038	775,703	54,062	492,788
Other	Lb.	1,097,725	828,402	1,320,784	897,464	2,665,439	1,012,508

Export of Chemicals and Allied Products—Continued

		12 Months Ended December				11 Months Ended November	
		1924		1925		1926	
		Quantity	Value	Quantity	Value	Quantity	Value
Acids and anhydrides							
Acetic	Lb.	707,078	$78,797	656,840	$72,294	427,489	$51,504
Sulphuric	Lb.	11,272,673	180,012	7,537,134	151,819	8,585,799	161,042
Boric	Lb.	727,082	79,081	756,234	78,158	1,336,354	119,336
All other	Lb.	10,767,011	721,472	14,184,818	670,813	12,895,574	597,506
Alcohols							
Methanol, pure and denaturing	Gal.	640,637	686,911	408,185	321,308	408,561	303,124
Other alcohol	pf. Gal.	312,187	213,298	454,018	387,432	399,315	210,645
Ammonia and ammonium compounds	Lb.	3,496,363	916,403	4,521,008	870,987	4,181,918	600,017
Aluminum sulphate	Lb.	32,024,282	407,749	41,512,316	505,537	56,751,422	851,208
Baking powder	Lb.	3,952,340	1,534,886	4,026,317	1,533,222	4,059,841	1,472,882
Calcium compounds							
Acetate of lime	Lb.	23,166,759	733,137	22,038,213	684,577	17,914,211	595,087
Calcium carbide	Lb.	9 667 546	428,492	4,854,637	208,354	4,262,700	169,916
Bleaching powder	Lb.	21,602,125	380,156	27,389,007	472,497	19,717,582	363,145
Copper sulphate	Lb.	2,988,039	142,626	6,139,344	285,870	4,501,188	216,044
Dextrine or British gum	Lb.	22,190,677	899,991	22,678,346	1,030,859	19,968,584	808,930
Formaldehyde	Lb.	2,897,822	322,214	2,799,116	291,156	2,149,852	203,031
Glycerin	Lb.	1,415,882	237,639	1,367,191	282,078	742,022	184,731
Petroleum jelly	Lb.	10,020,740	1,228,923	6,482,077	1,074,973	4,783,519	826,271
Potash							
Bichromate of	Lb.	1,169,266	100,017	461,710	35,795	116,141	9,411
Other	Lb.	2,675,331	201,019	3,848,478	362,945	3,103,967	295,555
Sodas and sodium compounds							
Cyanide	Lb.	4,210,172	489,524	1,591,633	273,937	1,700,290	278,772
Borax	Lb.	33,741,676	1,601,375	33,888,135	1,528,035	26,746,194	1,171,337
Soda Ash	Lb.	28,683,296	683,118	32,380,108	775,478	36,008,849	863,748
Silicate	Lb.	32,705,216	301,571	40,517,037	353,944	44,760,145	368,061
Sal soda	Lb.	13,078,544	199,133	13,391,541	195,329	11,964,922	150,909
Caustic	Lb.	92,115,631	2,862,809	100,954,500	2,995,724	92,069,629	2,778,673
Bicarbonate	Lb.	15,223,786	333,337	17,297,561	250,585	17,898,459	364,214
Other sodium compounds	Lb.	95,772,336	2,033,563	108,025,316	1,435,094	80,711,702	1;268,712
Washing powder and fluid	Lb.	4,420,398	260,350	4,515,511	273,624	4,550,168	243,869
Other chemicals, medicinal and pharmaceutical	Lb.	75,551,614	7,293,001	82,385,612	9,073,590	86,262,956	8,499,878
Pigments, paints and varnishes			14,326,200		18,511,010		16,977,168
Mineral with pigments, ocher, umber, sienna, metallic, whiting, etc	Lb.	28,206,731	823,563	31,267,496	903,822	29,249,787	907,853
Chemical pigments							
Zinc oxide	Lb.	7,854,394	605,630	21,710,048	1,503,561	23,518,293	1,582,517
Lithopone	Lb.	1,845,073	104,783	2,573,354	132,771	3,001,617	310,507
Carbon black	Lb.	34,428,855	3,385,852	43,182,635	3,555,769	34,272,625	3,216,570
Red lead	Lb.	1,880,263	210,598	1,604,497	183,591	1,424,256	170,244
White lead	Lb.	10,109,455	853,444	13,663,309	1,293,168	11,872,215	1,066,148
Other chemical pigments	Lb.	5,156,313	614,385	6,525,822	760,079	5,193,164	662,632
Paints, stains and enamels							
Enamel paints	Lb.	1,874,598	483,079	2,662,780	882,451	390,880	1,042,259
Other ready-mixed paints	Gal.	2,015,849	4,029,931	2,236,847	4,657,782	1,984,310	4,109,268
Other paints	Lb.	8,383,119	1,485,066	11,437,948	2,363,353	9,235,282	1,955,071
Varnishes							
Oil varnishes	Gal.	652,312	1,122,982	712,003	1,279,373	579,311	1,024,628
Other varnishes	Gal.	283,835	483,686	395,039	745,650	442,464	832,891
Fertilizers and fertilizer materials	Ton	1,068,325	16,508,398	1,147,386	17,298,529	1,025,386	18,158,747
Sulphate of ammonia	Ton	118,367	6,918,598	123,141	6,748,728	158,582	8,660,586
Phosphate materials							
Phosphate rock—							
High-grade hard rock	Ton	150,746	1,814,194	159,061	2,283,327	98,422	1,159,679
Land pebble	Ton	656,005	3,209,965	697,891	3,287,370	597,749	2,963,164
Other phosphate rock	Ton	12,022	96,673	13,324	107,317	10,728	81,488
Superphosphates (acid phosphate)	Ton	45,751	588,620	66,879	1,077,189	60,225	950,632
Other fertilizers	Ton	44,942	1,901,722	50,365	1,896,890	67,441	3,024,368
Explosives	Lb.	19,433,518	2,889,699	23,182,323	3,790,109		3,913,051
Smokeless powder	Lb.	291,929	135,588	1,126,489	620,522	611,912	451,483
Other gunpowder	Lb.	576,292	167,854	445,811	146,599	635,458	150,074
Blasting powder	Lb.	2,485,143	181,822	2,671,544	194,724	1,660,412	123,945
Dynamite	Lb.	15 160,391	2,201,476	16,986,044	2,444,362	14,581,776	2,108,249
Other explosives	Lb.	919,763	202,959	1,952,425	383,902	917,492	276,219
Soap							
Toilet or fancy	Lb.	5,376,453	2,400,616	6,749,339	2,803,308	8,237,169	2,771,775
Laundry	Lb.	54,276,016	3,814,139	55,784,860	4,008,480	53,206,338	3,773,432
Other soap	Lb.	17,724,053	1,517,948	13,098,254	1,221,535	12,634,248	1,147,184
Perfumery and toilet waters	Lb.	400,435	409,638	465,179	450,751		358,632
Talcum and other toiler powders	Lb.	3,228,723	1,688,211	3,468,579	1,882,156	3,051,309	1,603,779
Creams, rouges, and other cosmetics	Lb.	2,267,469	1,186,569	2,535,379	1,331,409	2,634,420	1,491,072
Dentifrices	Lb.	3,078,303	2,793,170	3,405,724	3,211,272	445,962	330,262
Other toilet preparations	Lb.	1,586,091	1,174,343	1,737,211	1,202,737	1,642,276	1,195,027
Pyroxylin products, known as celluloid, pyralin, viscoloid, fiberloid, etc.							
In blocks, sheets, or rods	Lb.	2,003,983	2,017,417	2,464,222	2,087,277	2,187,253	1,600,276
Manufactures of	Lb.	788,802	1,045,318	1,939,568	1,923,902	2,074,776	1,975,912
Blackings and polishes							
Shoe polishes	Lb.	5,639,884	1,331,685	5,257,091	1,303,315	3,110,350	912,636
Other blackings and polishes	Lb.	2,407,087	454,194	2,607,897	522,382	3,174,615	566,764
Clays							
Fire clay		37,236	312,676	39,308	350,445	39,282	315,731
Other clays		27,724	420,040	34,827	530,995	34,684	582,356
Graphite							
Unmanufactured	Lb.	2,043,411	144,108	1,888,868	142,102	672,045	41,251
Manufactures of	Lb.	1,529,935	250,957	2,381,526	337,501		
Metal polishes	Lb.	3,397,924	401,042	2,808,197	343,316	3,277,714	437,155
Asbestos							
Unmanufactured	Ton	1,134	93,163	990	70,846	701	68,967
Paper, millboard and roloboard	Lb.	2,171,674	124,228	2,159,826	119,311	1,694,531	143,113
Pipe covering and cement	Lb.	4,848,030	288,266	4,553,452	280,082	3,854,572	234,459
Textiles, yarn and packing	Lb.	1,197 508	788 361	1,369,738	803,037	1,289,020	737,506
Other manufactures of asbestos, except roofing	Lb.			1,203,299	863,078	2,687,599	312,241
Carbons, carbon brushes and electrodes	Lb.	31,497,325	2,978,857			48,703,343	2,691,212
Chalk, manufactures of	Lb.	1,028,439	120,621	1,626,815	236,356	1,511,772	201,350
Gypsum or plaster, crude, ground, calcined, and manufactures of	Lb.	21,246,736	358,425	33,595,982	498,616	35,686,925	528,179
Fire clay bricks	M	24,056	709,650	22,898	642,135	23,673	649,758
Other refractory bricks	M	12,732	1,126,678	14,063	1,313,280	13,094	1,279,483
Refractory shapes	Lb.	31,530,589	753,762	27,024,676	682,963	26,170,884	655,382
Crucibles	No.	548,893	96,001	408,249	91,699	576,125	142,429
Nickel, monel metal and alloys	Lb.	1,915,456	565,911	2,564,123	833,823	1 481,100	399,199
Bauxite	Ton	77,065	3,979,823	78,570	4,133,825	78,495	4,209,183

Imports of Chemicals and Allied Products

		12 Months Ended December				11 Months Ended November	
		1924		1925		1926	
		Quantity	Value	Quantity	Value	Quantity	Value
Albumen, egg	Lb.	3,763,936	$2,323,099	8,517,265	$3,880,839	7,012,162	$2,740,136
Animal and fish oils, fats and greases							
Whale oil	Gal.	5,074,271	2,515,325	7,399,372	4,328,414	7,913,502	4,018,297
Cod and cod-liver oil	Gal.	2,846,588	1,572,308	2,975,557	1,920,069	3,931,601	2,590,344
Other fish oils	Gal.	751,374	253,823	825,995	335,489	1,768,758	672,270
Grease and oils, n.e.s	Lb.	....	236,237	....	202,185	....	560,182
Gelatin, edible	Lb.	3,089,002	611,061	3,119,709	637,391	2,160,869	443,757
other	Lb.	1,870,336	1,174,422	1,675,431	1,001,459	1,895,797	1,108,066
Glue and glue size	Lb.	7,645,276	617,115	5,241,354	474,975	6,201,504	493,165
Casein	Lb.	17,749,985	1,384,661	18,803,816	1,573,335	24,817,424	2,683,068
Beeswax and other animal wax	Lb.	3,096,413	717,581	3,556,794	1,170,454	4,187,607	1,462,527
Oil cake and meal							
Bean	Lb.	47,084,672	895,869	27,801,936	535,800	39,315,276	813,841
Coconut	Lb.	67,676,940	891,842	30,371,260	463,807	37,187,093	431,381
All other	Lb.	39,809,932	693,931	30,362,210	580,075	33,915,364	688,386
Vegetable tallow	Lb.	5,196,904	367,581	6,423,896	505,497	3,560,505	295,910
Vegetable wax	Lb.	7,864,644	1,293,458	6,513,825	1,312,692	6,982,679	1,827,689
Varnish, gums and resins							
Damar	Lb.	9,625,694	1,088,111	12,697,218	1,568,894	13,746,080	2,060,237
Kauri	Lb.	5,869,308	1,102,381	4,634,495	813,234	5,015,937	893,283
Shellac	Lb.	24,552,998	13,139,000	19,912,799	10,164,050	29,229,111	9,912,764
All other	Lb.	27,821,690	4,013,934	37,037,081	5,856,599	45,077,667	5,746,291
Tar, pitch, and turpentine	Lb.	....	152,323	....	277,032	....	485,434
Gum, Arabic	Lb.	7,306,795	762,462	7,256,155	782,882	9,431,895	926 611
Tragacanth	Lb.	831,225	300,739	966,498	427,885	1,236,793	633,907
Gambier	Lb.	4,691,340	483,454	3,881,192	536,305	3,738,558	344,831
All other	Lb.	7,596,350	750,356	17,230,075	1,437,834	19,817,646	1,533,657
Oil seeds							
Cotton seed	Lb.	95,052,650	1,399,485	63,831,982	804,668	56,679,674	725,725
Castor beans	Lb.	84,977,470	3,790,112	107,231,669	4,840,512	92,056,751	3,129,012
Copra	Lb.	291,064,369	12,857,226	364,075,612	18,081,050	417,567,150	21,610,614
Flaxseed	Bu.	16,588,881	30,037,639	30,037,639	39,682,722	21,360,203	39,253,841
Poppy seed	Lb.	5,464,208	458,027	3,534,761	350,779	4,651,337	478,768
Other oil seeds	Lb.	28,658,872	1,176,314	20,016,223	965,369	21,968,527	841,458
Vegetable oils and fats							
China wood oil	Gal.	81,587,854	11,091,776	101,553,519	11,385,848	92,947,034	10,471,428
Coconut oil, free	Lb.	224,634,804	17,288,232	232,498,697	19,649,542	203,804,608	16,990,153
duty	Lb.	128,065	13,153	675,755	76,185	....	....
Cocoa butter	Lb.	1,778,859	309,767	63,831	18,027	85,509	23,059
Olive oil, edible	Lb.	76,186,446	12,584,969	90,426,346	15,656,307	84,311,776	14,554,579
inedible	Gal.	31,917,636	2,960,196	51,706,955	4,467,198	47,088,814	4,089,893
Palm oil	Lb.	101,779,802	7,002,462	139,178,587	11,040,372	126,084,827	9,773,971
Peanut oil	Lb.	15,394,836	1,325,538	3,026,950	387,173	8,025,365	827,382
Linseed oil	Lb.	13,247,190	1,067,351	13,607,141	1,406,730	15,039,688	1,032,551
Soya bean oil	Lb.	9,125,158	623,798	19,492,900	1,507,219	28,727,153	2,041,673
Other vegetable oils, free	Lb.	10,984,930	1,244,259	10,386,298	1,331,920	7,474,417	931,183
duty	Lb,	6,426,678	481,842	795,830	85,302	13,582,189	1,456,818
Dyeing and tanning materials (vegetable)							
Logwood	Ton	14,928	252,725	22,788	402,923	21,623	445,578
Myrobalans	Ton	10,041	226,609	10,830	422,211	12,686	446,462
Quebrachowood	Ton	24,588	335,092	22,739	386,574	32,068	510,276
Sumac	Ton	4,919	474,461	2,856	346,411	3,505	279,818
Valonia	Lb.	16,681,371	244,396	19,735,139	343,963	14,954,012	255,121
Other crude	Lb.	50,993,992	900,730	55,188,683	1,242,826	63,926,817	1,241,416
Extracts for dyeing, etc	Lb.	3,035,977	292,947	3,817,305	340,310	2,266,049	220,629
Extracts for tanning							
Quebracho	Lb.	92,544,284	2,583,795	113,176,692	3,945,824	90,396,529	3,268,054
All other	Lb.	7,104,507	192,443	3,988,401	142,102	2,739,462	90,795
Starch	Lb.						
Mineral oil							
Crude petroleum	Gal.	3,266,557,267	73,841,507	2,601,618,172	75,406,956	2,326,579,425	72,067,238
Tops and distillates	Gal.	15,072,867	984,141	8,812,744	661,345	9,020,531	456,652
Gasoline, naphthas	Gal.	145,022,774	13,135,341	160,137,182	15,978,296	235,162,439	24,328,157
Illuminating oil	Gal.	417,544	64,732	809,782	132,629	3,096,721	233,543
Lubricating oils	Gal.	451,987	87,003	1,573,949	286,387	1,348,141	255,479
Paraffin and paraffin wax	Lb.	12,866,607	645,365	14,588,124	1,003,385	8,794,042	576,220
Asphalt and bitumen	Ton	143,231	1,203,159	109,073	907,424	113,087	920,992
Lime and limestone crude	100 lb.	46,960,959	382,961	38,276,744	290,893	49,152,415	334,037
Kaolin, china and paper clay	Ton	315,437	3,189,846	332,622	3,195,527	325,590	3,206,087
Other clays	Ton	81,390	816,038	53,912	639,471	79,242	764,886
Chalk, unmanufactured	Ton	107,081	131,101	102,657	120,908	90,754	117,159
manufacturers of	Lb.	16,718,125	142,757	17,762,670	160,707	20,586,043	138,888
Pyrites or sulphuret of iron	Ton	246,737	598,544	276,385	773,925	349,378	822,577
Talcum, steatite, French chalk	Lb.	36,398,433	356,629	41,980,365	449,338	45,467,292	520,557
Salt	100 lb.	199,223,683	343,391	160,021,407	319,783	119,017,996	202,430
Mineral wax	Lb.	3,068,819	207,833	6,175,184	361,767	7,811,648	450,959
Chrome ore	Lb.	118,343	1,095,603	149,739	1,207,430	204,220	1,576,049
Aluminum ore, crude bauxite	Ton	201,974	909,493	353,696	1,619,120	268,118	1,123,195
Antimony ore	Lb.	1,797,950	62,999	4,256,371	47,084	7,739,141	266,899
Quicksilver	Lb.	905,678	520,870	1,708,560	1,321,586	1,960,430	1,746,651
Zinc dust	Lb.	186,663	29,120	291,979	38,655	....	40,631
Chemicals and allied products, free	....	....	89,364,437	....	98,494,752	....	85,022,276
(total) duty	....	....	32,361,330	....	41,891,138	....	39,855,882
Chemicals (total)	....	....	43,122,533	....	48,896,441	....	50,607,974
Coal-tar chemicals (total)	....	....	20,118,924	....	20,656,868	....	18,731,699
Coal-tar products, crude:							
Dead or creosote oil	Gal.	89,687,784	13,463,689	84,868,568	10,973,491	83,747,015	11,232,556
Pyridine	Lb.	608,980	268,782	789,077	394,337	718,372	354,657
Other crude coal-tar products	....	....	471,730	....	526,114	....	919,678
Intermediates							
Acids	Lb.	295,281	77,423	336,809	93,080	508,314	131,265
Other intermediate products	Lb.	3,811,819	729,617	2,240,564	1,004,792	877,850	536,506
Finished products							
Alizarin and derivatives	Lb.	151,609	214,394	47,583	74,635	20,699	37,505
Colors or dyes, n.e.s	Lb.	3,433,946	4,459,456	5,782,329	7,162,677	4,670,415	5,239,940

Imports of Chemicals and Allied Products—Continued

		12 Months Ended December				11 Months Ended November	
		1924		1925		1926	
		Quantity	Value a	Quantity	Value	Quantity	Value
Colors, dyes, stains, color acids, and color bases, n.e.s.	Lb.	3,433,946	$4,459,456	5,782,329	$7,162,677	4,670,415	$5,239,940
Imported from							
Germany	Lb.	1,652,784	2,079,059	2,932,216	3,757,846	2,083,511	2,226,418
Switzerland	Lb.	1,118,215	1,523,829	1,970 951	2,260,165	1,748,794	2,023,147
United Kingdom	Lb.	107,510	102,526	170,443	144,621	166,841	167,839
Other countries	Lb.	268,321	341,641	387,646	587,911	415,228	488,077
Coal-tar medicinals	Lb.	92,203	255,975	107,889	253,349	60,761	226,385
Other finished coal-tar products	Lb.	12,080	14,084	13,599	38,922	19,716	53,207
Other chemicals							
Acids and anhydrides							
Arsenious acid or white arsenic	Lb.	17,703,996	1,591,138	18,631,387	1,076,073	15,063,169	499,579
Citric	Lb.	744,624	206,107	687,010	162,473	137,984	35,944
Formic	Lb.	1,543,998	122,119	1,487,149	105,155	2,078,500	147,296
Oxalic	Lb.	3,155,591	178,902	2,590,149	118,178	1,464,900	65,741
Sulphuric	Lb.	15,249,265	130,552	36,382,941	241,515	53,069,661	323,559
Tartaric	Lb.	2,986,680	617,140	3,580,253	702,183	1,486,292	393,096
All other — free	Lb.	355,022	5,339	1,617,254	20,400	1,633,046	13,826
All other — dut.	Lb.	2,682,964	351,112	5,216,679	693,575	9,892,870	867,151
Alcohols, including fusel oil			504,075		734,837		342,251
Ammonia compounds, n.e.s.							
Muriate of ammonia	Lb.	9,791,100	453,783	10,990,274	462,129	13,290,605	523,314
Nitrate	Lb.	3,747,531	209,399	10,871,929	541,672	7,016,048	328,802
All other	Lb.	1,936,495	78,348	2,030,501	91,222	1,113,637	61,258
Barium compounds	Lb.	14,049,906	353,628	20,111,707	297,945	23,417,668	295,738
Cobalt oxide	Lb.	226,703	440,898	287,265	546,292	308,502	586,164
Copper sulphate	Lb.	3,866,006	162,472	1,805,095	92,930	2,414,387	111,339
Lime							
Chlorinated, or bleaching powder	Lb.	1,267,427	54,644	2,099,683	62,233	3,282,019	74,510
Citrate	Lb.	2,505,444	256,807	3,430,875	342,532	3,371,409	339,393
Glycerin	Lb.	15,927,701	1,729,461	21,292,301	2,540,747	36,126,675	5,899,120
Iodine, crude	Lb.			246,474	889,860	641,089	2,039,199
Potassium compounds							
Cyanide	Lb.	2,918,536	239,749	2,298,964	216,683	200,077	41,594
Carbonate	Lb.	6,277,813	243,545	7,895,425	348,174	10,642,209	492,767
Hydroxide	Lb.	12,657,186	700,242	12,256,971	733,849	11,642,486	690,376
Nitrate	Ton	689	54,628	8,396	447,717	9,416	526,569
Bitartrate, crude, argols	Lb.	16,743,935	1,094,475	24,665,695	1,689,758	24,205,275	1,691,272
Cream of tartar	Lb.	1,525,894	166,596	338,297	48,062	214,402	29,873
Potassium chlorate and perchlorate	Lb.	7,487,366	309,083	11,834,182	481,341	11,558,497	424,204
Other potassium compounds	Lb.	6,341,178	439,571	10,255,796	624,589	10,556,772	560,666
Sodium compounds							
Cyanide	Lb.	29,737,115	2,658,006	30,212,429	2,600,433	29,636,822	2,499,127
Ferrocyanide	Lb.	3,153,250	267,199	1,636,894	115,085	759,013	51,724
Nitrite	Lb.	4,578,091	180,816	1,971,105	78,149	1,906,855	68,989
All others, n.e.s. — free	Lb.	15,609,590	156,598	15,026,201	188,908	18,785,636	161,408
All others, n.e.s. — dut.			445,170		537,480		1,046,880
All other chemicals, n.e.s. — free			736,344		768,357		520,754
All other chemicals, n.e.s. — dut.			2,223,984		2,998,055		3,025,836
Paints, pigments, and varnishes (total)			2,822,702		3,235,210		3,492,206
Mineral earth pigments							
Ochers and siennas — dut.	Lb.	19,657,287	249,689	20,138,814	275,020	20,086,861	373,577
Other — dut.	Lb.	76,622,149	835,218	82,591,012	935,234		422,443
Chemical pigments							
Zinc pigments — dut.	Lb.	17,265,086	795,131	15,528,845	719,877		802,969
All other — dut.			491,989		735,094	17,006,797	529,728
Paints, stains, and enamels — dut.	Lb.	1,086,758	376,752	1,557,969	518,743	2,043,303	679,202
Varnishes — dut.	Gal.	30,755	73,923	19,000	51,242	32,077	68,832
Fertilizers (total)	Ton	1,892,880	66,531,495	2,268,438	78,071,966	1,890,801	63,683,594
Nitrogeneous							
Calcium cyanamid	Ton	75,558	3,687,794	97,954	4,689,438	72,282	3,809,132
Calcium nitrate	Ton	7,682	347,304	7,777	328,208	12,064	533,848
Sodium nitrate	Ton	986,608	47,169,496	1,112,226	52,503,877	850,635	40,084,651
Sulphate of ammonia	Ton	6,000	342,000	23,762	1,325,743	8,178	459,234
Guano	Ton	25,245	754,683	17,407	730,046	11,136	414,338
Dried blood	Ton	7,191	403,865	10,189	588,127	9,370	573,275
Tankage	Ton	21,717	676,201	30,000	1,018,207	21,653	881,902
	Ton	47,575	1,085,070	72,792	1,940,793		
Phosphate							
Bone phosphate	Ton	22,242	706,727	24,981	724,473	41,244	1,227,730
Other phosphate material	Ton	22,886	257,692	11,286	189,645	21,906	280,172
Potash fertilizers							
Chloride, crude (muriate of potash)	Ton	128,803	3,972,366	161,028	5,193,866	178,798	5,543,864
Sulphate, crude	Ton	75,657	2,856,503	68,952	2,686,408	63,313	2,566,880
Kainite	Ton	154,954	913,816	182,828	1,173,125	151,498	1,006,689
Manure salts	Ton	226,144	2,217,974	384,232	3,676,620	280,727	2,971,053
Other potash-bearing substances	Ton	46,461	479,585	23,597	320,889	46,306	478,049
All other fertilizers	Ton	38,157	660,419	39,367	955,501	51,395	667,226
Explosives							
Azides, fulminates, dynamite, etc., and powder from country imposing duty			39,857		184,769		207,589
Firecrackers	Lb.	5,193,314	818,873	4,188,368	850,787	3,497,214	748,687
Fireworks and ammunition	Lb.	464,589	99,181	286,795	86,270		156,344
Soap							
Castile	Lb.	1,740,562	206,874	1,823,541	230,236	1,879,383	226,479
Toilet	Lb.	25,300	2,000			1,127,942	376,178
All other	Lb.	908,514	316,418	1,073,716	383,015	2,750,529	288,118
Rubber and similar gums and manufactures of			179,868,652		437,197,538		482,009,694
Rubber, crude and milk of	Lb.	734,845,218	174,231,331	888,478,385	429,705,014	841,310,450	472,557,513
Jelutong	Lb.	13,809,583	1,237,100	15,118,547	1,642,531	15,051,793	2,863,528
Balata	Lb.	1,038,376	568,356	1,158,858	574,750	643,939	268,982
Gutta-percha	Lb.	3,154,731	463,610	3,591,081	629,284	2,950,919	620,446
Guayule	Lb.	3,037,683	536,392	8,469,123	1,803,448	9,143,747	2,440,594
Other crude	Lb.	12,167,633	417,046	25,458,639	983,406	30,708,778	1,399,636
Rubber belting	Lb.	582,096	397,867	748,580	559,908	704,771	471,187
Other manufactures			2,016,850		1,298,197		1,229,417
Camphor							
Natural, crude	Lb.	1,847,785	998,832	2,369,413	1,301,032	1,954,691	1,121,661
Refined	Lb.	2,861,654	1,781,417	1,583,902	953,126	1,035,542	676,536
Synthetic	Lb.			1,834,988	920,936	2,699 883	1,433,022

Comparative Prices in the New York Market, 1926

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. producing points, the quotations are given on that basis and are so designated. The figures show the opening price, the high, the low and the closing price for 1926.

Industrial Chemicals

		Jan. 1	High	Low	Dec. 31
Acetone, drums	lb.	$0.12	$0.12	$0.12	$0.12
Acid, acetic, 28% bbl	100 lb.	3.25	3.38	3.25	3.38
Boric, bbl	lb.	.09	.09	.08½	.08½
Citric, kegs	lb.	.45½	.46½	.44½	.44½
Lactic, 44%, tech., light, bbl	lb.	.13½	.13½	.13½	.13½
22% tech., light, bbl	lb.	.06½	.06½	.06½	.06½
Muriatic, 18° tanks	100 lb.	.80	.85	.80	.85
Nitric, 36° carboys	100 lb.	5.00	.500	5.00	5.00
Oxalic, crystals, bbl	lb.	.10¾	.13½	.10¾	.10¾
Sulphuric, 60°, tanks	tons	9.50	10.00	9.50	10.00
Tartaric, powd., bbl	lb.	.28	.28	.26½	.27½
Alcohol Ethyl, 190 p'f. U.S.P., bbl	gal.	4.94	4.94	4.90	4.90½
Alcohol, denatured, 190 proof					
No. 1 special dr	gal.	.53½	.53½	.28	.31
No. 5, 188 proof, dr	gal.	.53½	.53½	.30	.33
Alum., ammonia, lump, bbl	lb.	.03½	.03½	.03½	.03½
Potash, lump, bbl	lb.	.02¾	.03	.02¾	.02¾
Aluminum sulphate, com., bags	100 lb.	1.35	1.40	1.35	1.40
Aqua ammonia, 26°, tanks	lb.	.06½	.06½	.03	1.40
Ammonia, anhydrous, cyl	lb.	.15	.15	.11	.03
Ammonium carbonate, powd. tech., casks	lb.	.09	.09	.08½	.08¾
Ammonium sulphate, wks	100 lb.	2.90	2.90	2.45	2.50
Amylacetate tech., drums	gal.	2.50	2.50	1.60	1.60
Arsenic, white, powd., bbl	lb.	.03¾	.04½	.03	.03¾
Arsenic, red, powd., kegs	lb.	.12	.12	.10½	.10¾
Barium carbonate, bbl	ton	45.00	54.00	42.00	48.00
Barium chloride, bbl	ton	59.00	66.00	57.00	62.00
Barium, nitrate, casks	lb.	.07¾	.08	.07½	.07½
Bleaching powd., f.o.b. wks., drums	100 lb.	1.90	2.00	1.90	2.00
Borax, bbl	lb.	.05	.05	.04½	.04½
Calcium acetate, bags	100 lb.	3.25	3.50	3.25	3.50
Calcium arsenate, dr	lb.	.07	.11	.05½	.06½
Calcium carbide drums	lb.	.05½	.05½	.05½	.05½
Calcium chloride, fused, dr. wks	ton	21.00	21.00	21.00	21.00
Carbon bisulphide, drums	lb.	.05½	.05½	.05½	.05½
Carbon tetrachloride drums	lb.	.06¾	.07	.06¾	.07
Chlorine, liquid, tanks, wks	lb.	.04	.04	.04	.04
Cobalt, oxide bbl	lb.	2.10	2.10	2.10	2.10
Copperas, bulk, f.o.b. wks	ton	13.00	16.00	13.00	16.00
Copper carbonate, bbl	lb.	.16¾	.17	.16½	.17
Copper sulphate, bbl	100 lb.	.04½	.04¾	.04½	.04¾
Imp. bbl	100 lb.	.04½	.04¾	.04½	.04½
Cream of tartar, bbl	lb.	.20½	.22	.20½	.21
Epsom salt, dom., tech., bbl	100 lb.	1.50	1.75	1.50	1.75
Epsom salt, imp., tech., bags	100 lb.	1.25	1.25	1.15	1.15
Ethyl acetate, 85% drums	gal.	.82	.82	.74	.77
Formaldehyde, 40%, bbl	lb.	.09	.11½	.09	.11½
Fusel oil, crude, drums	gal.	1.80	1.80	1.35	1.35
Glaubers salt, bags	100 lb.	.75	1.10	.75	1.10
Glycerine, c.p., drums, extra	lb.	.25	.30	.25	.30
Lead:					
White, basic carbonate, dry, casks	lb.	.10¾	.10¾	.09½	.09½
White, basic sulphate, casks	lb.	.10	.10	.09¾	.09¾
Lead acetate, white crys., bbl	lb.	.14½	.14½	.14½	.14½
Lead arsenate, powd., bbl	lb.	.13	.14	.13	.14
Lithopone, bags	lb.	.06	.06	.06½	.06½
Magnesium carb., tech., bags	lb.	.06¼	.06¼	.06¼	.04¼
Methanol, 95%, dr	gal.	.57	.80	.55	.80
Methanol, 97%, dr	gal.	.59	.82	.57	.82
Nickel salt, double, bbl	lb.	.10	.10	.10	.10
Nickel salts, single, bbl	lb.	.10½	.10½	.10½	.10½
Phosphorus, red, cases	lb.	.70	.70	.62	.65
Phosphorus, yellow, cases	lb.	.35	.35	.32	.32
Potassium bichromate, casks	lb.	.08¼	.08½	.08	.08¼
Potassium carbonate, 80-85%, calcined, casks	lb.	.06	.06	.05½	.05½
Potassium chlorate, powd	lb.	.08¼	.08½	.08¼	.08¼
Potassium hydroxide (caustic potash) drums	lb.	.07¼	.07½	.07½	.07½
Potassium muriate, 80% bags	ton	34.90	36.40	3.490	36.40
Potassium nitrate, bbl	lb.	.06	.06	.60	.60
Potassium permanganate, drums	lb.	.14¼	.14½	.14	.14½
Potassium prussiate, red, casks	lb.	.37¾	.38	.37½	.38
Potassium prussiate, yellow, caks	lb.	.18	.19	.18	.19
Salammoniac, white, imp., casks	lb.	.05¼	.06½	.05½	.06¼
Salsoda, bbl	100 lb.	.95	1.10	.95	.95
Soda ash, light, 58% bags, contract	100 lb.	1.38	1.38	1.32½	1.32½
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10	3.10	3.00	3.00
Sodium acetate, works, bbl	lb.	.05	.05	.04¼	.04½
Sodium bicarbonate, 330-lb. bbl	100 lb.	2.00	2.00	2.00	2.00
Sodium bichromate, casks	lb.	.06½	.06¾	.06	.06½
Sodium chlorate, kegs	lb.	.06¼	.06¾	.06¼	.06¼
Sodium cyanide, cases, dom	lb.	.20	.22	.20	.20
Sodium cyanide, imp. cases	lb.	.19	.19	.18	.18
Sodium fluoride, bbl	lb.	.08¾	.12	.08¾	.11
Sodium nitrate, bags	100 lb.	2.65	2.71	2.33	2.63
Sodium nitrite, casks	lb.	.09	.09	.08¾	.09
Sodium phosphate, dibasic, bbl	lb.	.03½	.03½	.03½	.03½
Sodium prussiate, yel. drums	lb.	$0.09¼	$0.11	$0.09½	$0.10½
Sodium silicate (40°, drums)	100 lb.	.75	.75	.75	.75
Sodium sulphide, fused, 60–62% drums	100 lb.	3.00	3.00	3.00	3.00
Sodium sulphite, crys., bbl	lb.	.03¼	.03¼	.02¾	.02¾
Strontium nitrate, powd., bbl	lb.	.09	.09½	.07¾	.07¾
Sulphur, crude at mine, bulk	ton	17.00	19.00	17.00	19.00
Tin bichloride, bbl	lb.	.17¾	.17¾	.14¾	.19¾
Tin oxide, bbl	lb.	.66	.66	.57	.72
Tin crystals, bbl	lb.	.43	.43	.37	.47
Zinc chloride, gran., bbl	lb.	.06	.07	.06	.07
Zinc oxide, lead free, bag	lb.	.07¾	.07½	.06½	.06½
5% lead sulphate, bags	lb.	.06¼	......	......	......
Zinc sulphate, bbl	100 lb.	3.00	3.00	2.75	2.75

Coal-Tar Products

		Jan. 1	High	Low	Dec. 31
Alpha-naphthol, crude, bbl	lb.	$0.60	$0.60	$0.60	$0.60
Alpha-naphthol, ref., bbl	lb.	.85	.85	.80	.80
Alpha-naphthylamine, bbl	lb.	.35	.35	.35	.35
Aniline oil, drums, extra	lb.	.16	.17	.15	.15
Aniline salts, bbl	lb.	.22	.23	.22	.22
Anthracene, 80%, drums	lb.	.60	.60	.60	.60
Benzaldehyde, tech., carboys	lb.	.70	.70	.65	.65
Benzene, 90%, tanks, works	gal.	.24	.24	.23	.24
Benzidine base, bbl	lb.	.72	.72	.70	.70
Benzoic acid, U.S.P., kegs	lb.	.56	.58	.56	.58
Benzoate of soda, U.S.P., bbl	lb.	.50	.50	.50	.50
Benzyl chloride, tech., drums	lb.	.25	.25	.25	.25
Beta-naphthol, tech., bbl	lb.	.22	.22	.22	.22
Beta-naphthylamine, tech	lb.	.65	.65	.65	.65
Creosol, U.S.P., drums	lb.	.20	.20	.17½	.17½
Cresylic acid, 97%, works drums	gal.	.59	.60	.58	.60
95-97%, drums, works	gal.	.57	.58	.57	.58
Diethylaniline, drums	lb.	.58	.58	.58	.58
Dimethylaniline, drums	lb.	.32	.32	.32	.32
Dinitrophenol, bbl	lb.	.31	.31	.31	.31
Dinitrotoluen, bbl	lb.	.18	.18	.18	.18
Diphenylamine, bbl	lb.	.48	.48	.45	.45
H-acid, bbl	lb.	.68	.68	.60	.60
Monochlorbenzene, drums	lb.	.07½	.07½	.07	.07
Monoethylaniline, drums	lb.	1.05	1.05	1.05	1.05
Naphthalene, flake, bbl	lb.	.05½	.05½	.04½	.04½
Naphthalene, balls, bbl	lb.	.06¾	.06¾	.05½	.05½
Naphthionate of soda, bbl	lb.	.55	.55	.51	.51
Naphthionic acid, crude, bbl	lb.	.55	.55	.55	.55
Nitrobenzene, drums	lb.	.09	.10	.09	.09½
N-W acid, bbl	lb.	.95	.95	.95	.95
Ortho-amidophenol, kegs	lb.	2.15	2.15	2.15	2.15
Ortho-dichlorbenzene, drums	lb.	.09	.09	.08½	.08½
Ortho-nitrophenol, bbl	lb.	.85	.85	.85	.85
Ortho-toluidine, bbl	lb.	.25	.25	.25	.25
Para-aminophenol, base, kegs	lb.	1.15	1.15	1.15	1.15
Para-dichlorbenzene, bbl	lb.	.17	.21	.17	.21
Para-nitroaniline, bbl	lb.	.52	.52	.52	.52
Para-nitrotoluene, bbl	lb.	.30	.30	.28	.28
Para-phenylenediamine, bbl	lb.	1.25	1.25	1.20	1.20
Para-toluidine, bbl	lb.	.55	.55	.49	.49
Phthalic anhydride, bbl	lb.	.18	.25	.18	.25
Phenol, U.S.P., dr	lb.	.21	.21	.17	.17
Picric acid, bbl	lb.	.30	.30	.30	.30
Resorcinol, tech., kegs	lb.	1.35	1.35	1.25	1.25
R-salt, bbl	lb.	.45	.46	.45	.46
Salicylic acid, tech., bbl	lb.	.33	.38	.33	.38
Salicylic acid, U.S.P., bbl	lb.	.34	.40	.34	.40
Solvent naphtha, crude, tanks	gal.	.35	.35	.35	.35
Sulphanilic acid, crude, bbl	lb.	.16	.16	.16	.16
Toluidine, mixed, kegs	lb.	.30	.32	.30	.31
Toluene, tank cars, works	gal.	.35	.35	.35	.35
Xylidine drums	lb.	.38	.38	.38	.38
Xylene, 5%, drums	gal.	.55	.55	.45	.45
Xylene, com., tanks	gal.	.36	.36	.36	.36

Oils and Fats

		Jan. 1	High	Low	Dec. 31
Castor oil, No. 3, bbl	lb.	$0.15	$0.15	$0.11¾	$0.12½
Chinawood oil, bbl	lb.	.13	.18	.11¾	.13½
Cocoanut oil, Ceylon, tanks, N. Y	lb.	.11	.12	.08½	.09½
Corn oil, Crude, tanks (f.o.b. mill)	lb.	.09¾	.12¾	.07½	.07½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09	.14	.06¼	.06½
Linseed oil, raw, car lots, bbl	lb.	12.01	12.04	10.04	10.03
Palm, Lagos, casks	lb.	.09½	.11	.08½	.08¾
Niger, casks	lb.	.08½	.10½	.07	.07¼
Peanut oil, crude, tanks (mill)	lb.	.10¼	.14	.09½	.10
Rapeseed oil, refined, bbl	gal.	.14½	.15½	.14½	.15
Sesame, bbl	lb.	.95	.95	.80	.80
Soya bean tank (f.o.b. coast)	lb.	.10¾	.12½	.09½	.10
Sulphur (olive foots), bbl	lb.	.08¼	.09¾	.08	.09½
Cod, Newfoundland, bbl	gal.	.63	.65	.60	.63
Menhaden, light pressed, bbl	gal.	.67	.69	.62	.62
Crude, tanks (f.o.b. factory)	gal.	.55	.55	.45	.45
Grease, yellow, loose	lb.	.08½	.09	.06¾	.06½
Oleo Stearine	lb.	.12¾	.15	.09½	.09¾
Red oil, distilled, d.p. bbl	lb.	.11	.11½	.09½	.09½
Tallow, extra, loose	lb.	.07½	.09	.07¾	.07½

Miscellaneous

		Jan. 1	High	Low	Dec. 31
Paraffine wax, crude, 124 m.p. bg	lb.	$0.05¾	$0.05¾	$0.05¾	$0.05¼
Rosin, B-D, bbl	280 lb.	13.60	15.40	12.00	12.25
Turpentine, spirits, bbl	gal.	1.01	1.03	.83	.85

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to January 16.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	\$0.12 -\$0.13	\$0.12 -\$0.13	\$0.12 -\$0.13
Acid, acetic, 28%, bbl.	cwt.	3.38 - 3.63	3.38 - 3.63	3.12 - 3.37
Boric, bbl	lb.	.08¾- .09	.09 - .10	.08½- .11
Citric, kegs	lb.	.44½- .45	.44½- .47	.45½- .47
Formic, bbl.	lb.	.10½- .11½	.10½- .11	.10 - .10½
Gallic, tech., bbl	lb.	.50 - .55	.50 - .55	.45½- .47
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06½- .07
Lactic, 44%, tech., light, bbl.	lb.	.13½- .14	.13½- .14	.13½- .14
22%, tech., light, bbl.	lb.	.06½- .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks	cwt.	.85 - .90	.85 - .90	.80 - .85
Nitric, 36°, carboys	cwt.	.05 - .05¼	.05 - .05½	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	16.00- 17.00
Oxalic, crystals, bbl.	lb.	.10¾- .11	.11 - .11½	.10¾- .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07¾- .08
Sulphuric, 60°, tanks	ton	10.50 -11.00	10.50 -11.00	8.50 - 9.50
Tannic, tech., bbl	lb.	.35 - .40	.35 - .40	.45 - .50
Tartaric, powd., bbl.	lb.	.29½- .30	.28 - .30	.27½- .30
Tungstic, bbl	lb.	1.00 - 1.20	1.00 - 1.20	1.20 - 1.25
Alcohol, ethyl, 190 p'f. U.S.P. bbl	gal.	4.90½- 5.00	4.90½- 5.00	4.94 - 5.04
Alcohol, Butyl, dr	lb.	.19¼- .19½	.20½- .20¾	.20 - .21
Denatured, 190 proof				
No. 1 special dr	gal.	.33 - .35	.31 - .36	.53½-......
No. 5, 188 proof, dr.	gal.	.33 - .35	.31 - .33	.53½-......
Alum, ammonia, lump, bbl	lb.	.03½- .04	.03½- .04	.03¾- .04
Chrome, bbl	lb.	.05½- .05¾	.05½- .05¾	.05½- .06
Potash, lump, bbl	lb.	.02¾- .03½	.02¾- .03½	.02¾- .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums	lb.	.02¾- .03	.03 - .03½	.03 - .04
Ammonia, anhydrous, cyl.	lb.	.11 - .13	.11 - .15	.15 - .17
Ammonium carbonate, powd. tech., casks	lb.	.08¼- .09	.08¾- .09	.11 - .11½
Sulphate, wks.	cwt.	2.50 -......	2.50 -......	2.95 -......
Amylacetate tech., drums	gal.	1.60 - 1.75	1.60 - 1.75	2.45 - 2.50
Antimony Oxide, bbl.	lb.	.15 - .16	.15½- .16½	.17 - .17½
Arsenic, white, powd., bbl.	lb.	.03½- .04½	.03½- .04½	.03¾- .04½
Red, powd., kegs	lb.	.10¾- .11	.10¾- .11	.12 - .12½
Barium carbonate, bbl.	ton	50.00 -52.00	48.00 -50.00	45.00 -48.00
Chloride, bbl.	ton	62.00 -65.00	62.00 -65.00	58.00 -66.00
Nitrate, cask	lb.	.07¾- .08	.07¾- .08½	.07½- .08
Blanc fixe, dry, bbl	lb.	.03¾- .04	.03¾- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	1.90 - 2.00
Borax, bbl.	lb.	.04¼- .04½	.04½- .05	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.47 - .48
Calcium acetate, bags	cwt.	3.50 -......	3.50 -......	3.00 - 3.25
Arsenate, dr	lb.	.06½- .08	.06½- .07	.07 - .08
Carbide drums	lb.	.05½- .06	.05½- .06	.05 - .05½
Chloride, fused, dr., wks.	ton	21.00 -......	21.00 -......	21.00 -......
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.06¾- .07½
Carbon bisulphide, drums	lb.	.05½- .06	.05½- .06	.06 - .06½
Tetrachloride drums	lb.	.06¾- .07	.06¼- .06½	.07 - .07½
Chlorine, liquid, tanks, wks.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.00 - 2.10	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	13.50 -14.00	16.00- 18.00	13.50 -14.00
Copper carbonate, bbl.	lb.	.17 - .17½	.17 - .18	.16¾- .17
Cyanide, tech., bbl	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	4.80 - 4.90	4.80 - 4.90	4.50 - 4.60
Cream of tartar, bbl.	lb.	.21½- .22	.21 - .22	.21½- .22
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.74 - .76	.74 - .76	.82 - .87
99%, dr.	gal.	1.03 -......	.95 - .96	1.05 - 1.10
Formaldehyde, 40%, bbl.	lb.	.11½- .11½	.11½- .11½	.09 - .09½
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.20 - .23½
Fusel oil, crude, drums	gal.	1.35 - 1.40	1.40 - 1.50	2.25 - 2.50
Refined, dr	gal.	2.50 - 3.00	2.50 - 3.00	3.25 - 3.50
Glaubers salt, bags	cwt.	1.00 - 1.15	1.00 - 1.10	1.20 - 1.40
Glycerine, c.p., drums, extra	lb.	.30 - .31	.29 - .30	.25 - .26
Lead:				
White, basic carbonate, dry, casks	lb.	.10½-......	.10½-......	.10½-......
White, basic sulphate, sck.	lb.	.09½-......	.09½-......	.09½-......
Red, dry, sck	lb.	.11¾-......	.11¾-......	.12¾-......
Lead acetate, white crys., bbl.	lb.	.14½- .15	.14½- .15	.14¾-......
Lead arsenate, powd., bbl	lb.	.14 - .15	.14 - .15	.13 - .14
Lime, chem., bulk	ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk	lb.	.11 -......	.11 -......	.11¾-......
Lithopone, bags	lb.	.05½- .06	.05½- .06	.06 - .06½
Magnesium carb., tech., bags	lb.	.06¼- .06½	.06¼- .06½	.06¾- .07
Methanol, 95%, dr	gal.	.80 -......	.80 -......	.57 - .60
97%, dr.	gal.	.85 -......	.77 - .80	.59 - .63
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl	lb.	.10½- .11	.10½- .11	.10 - .11
Orange mineral, csk	lb.	.13¾-......	.13¾-......	.14 -......
Phosphorus, red, cases	lb.	.62 - .65	.62 - .65	.70 - .75
Yellow, cases	lb.	.32 - .33	.32 - .34	.34 - .36
Potassium bichromate, casks	lb.	.08½- .08½	.08½- .08¾	.08½- .08½
Carbonate, 80-85%, calc., csk.	lb	.05½- .06	.06 -......	.06 - .06½
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.08½- .09
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.47 - .62
First sorts, csk.	lb.	\$0.09 -\$0.09½	\$0.08¾-\$0.09	\$0.08½-\$0.08½
Hydroxide (c'stic potash) dr.	lb.	.07½- .07¾	.07½- .07¾	.07½- .07½
Muriate, 80% bgs	ton	36.40 -......	36.40 -......	34.90 -......
Nitrate, bbl.	lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums	lb.	.14 - .15	.14 - .15	.14 - .15
Prussiate, yellow, casks	lb.	.18¾- .19	.19 - .19½	.18 - .18½
Sal ammoniac, white, casks	lb.	.05½- .06	.05½- .06¾	.05½- .06
Salsoda, bbl.	cwt.	.90 - .95	.90 - .95	1.10 - 1.20
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.32½-......	1.38 -......	1.38 -......
Dense, bags	cwt.	1.37½-......	1.45 - 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.00 -......	3.10 -......	3.10 -......
Acetate, works, bbl.	lb.	.04½- .05½	.04½- .05	.04½- .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	1.75 - 2.00
Bichromate, casks	lb.	.06½- .06½	.06½- .06¾	.06½- .06¾
Bisulphate, bulk	ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl.	lb.	.03¾- .04	.03¾- .04	.04½- .04½
Chlorate, kegs	lb.	.06¼- .06½	.06¼- .06½	.06¼- .06½
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.09½- .09¾	.09 - .09½	.09 - .09½
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	.02½- .02½
Nitrate, bags	cwt.	2.63 -......	2.60 -......	2.61 -......
Nitrite, casks	lb.	.08½- .09½	.08½- .09	.09 - .09½
Phosphate, dibasic, bbl.	lb.	.03¼- .03½	.03½- .03¾	.03½- .03¾
Prussiate, yel. drums	lb.	.11 - .11½	.10¾- .10½	.10½- .10½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 - .03½	.03 - .03½	.02¾- .03
Sulphite, crys., bbl	lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl.	lb.	.08½- .09	.08½- .09	.09½- .10
Sulphur, crude at mine, bulk	ton	19.00 -......	19.00 -......	15.00 -17.00
Chloride, dr	lb.	.04 - .05	.04 - .05	.04 - .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.08½- .09
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.25 - 2.35
Tin bichloride, bbl.	lb.	.19¼-......	.20¼-......	.17½-......
Oxide, bbl.	lb.	.70 -......	.72 -......	.66 -......
Crystals, bbl.	lb.	.46 -......	.48 -......	.43 -......
Zinc chloride, gran., bbl.	lb.	.06¼- .06½	.07 - .08	.06 - .07½
Carbonate, bbl.	lb.	.10 - .11	.11 - .11½	.12 - .14
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.10 - .10½	.09 - .10	.08 - .08½
Zinc oxide, lead free, bag.	lb.	.06¼-......	.07½-......	.07½-......
5% lead sulphate, bags	lb.	.06¼-......	.07 -......	.06¼-......
Sulphate, bbl	cwt	2.75 - 3.00	2.75 - 3.00	3.50 - 3.75

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	\$0.13 -\$0.13½	\$0.12½-\$0.13	\$0.15 -\$0.15½
Chinawood oil, bbl.	lb.	.14½- .15	.15 -......	.13 - .13½
Coconut oil, Ceylon, tanks, N. Y.	lb.	.08½-......	.08½-......	.12 -......
Corn oil crude, tanks, (f.o.b. mill)	lb.	.07 -......	.07½-......	.09½-......
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.07 -......	.06½-......	.08¾-......
Linseed oil, raw, car lots, bbl.	lb.	10.5 -......	11.0 -......	12.9 -......
Palm, Lagos, casks	lb.	.08¾- .09	.08½- .08½	.09½-......
Niger, casks	lb.	.07¾-......	.07¾- .08	.08¾-......
Palm Kernel, bbl.	lb.	.09 -......	.09 -......	.09½-......
Peanut oil, crude, tanks(mill)	lb.	.08½-......	.11 -......	.10 -......
Perilla, bbl	lb.	....-......	.15 - .15½	.14½-......
Rapeseed oil, refined, bbl.	gal.	.79 - .80	.80 - .82	.93 - .94
Sesame, bbl.	lb.	....-......	....-......	....-......
Soya bean tank (f.o.b. Coast)	lb.	.09½-......	.10½-......	.10½-......
Sulphur(olive foots), bbl.	lb.	.09½-......	.09½-......	.09 -......
Cod, Newfoundland, bbl	gal.	.63 - .66	.63 - .64	.64 - .65
Menhaden, light pressed, bbl	gal.	.58 - .60	.58 - .60	.72 - .74
Crude, tanks(f.o.b. factory)	gal.	.40 -......	.45 -......	.55 -......
Whale, crude, tanks	lb.	....-......	....-......	....-......
Grease, yellow, loose	lb.	.06½-......	.06¾-......	.09 - .09½
Oleo stearine	lb.	.08¾-......	.08¾-......	.14 -......
Red oil, distilled, d.p. bbl.	lb.	.09½- .10	.09½- .10	.11½- .11½
Tallow, extra, loose	lb.	.07½-......	.07½-......	.10 -......

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	\$0.60 -\$0.65	\$0.60 -\$0.65	\$0.60 -\$0.62
Refined, bbl	lb.	.85 - .90	.85 - .90	.75 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.15 - .16	.16 - .16½	.17 - .17½
Aniline salts, bbl	lb.	.24 - .25	.22 - .24	.20 - .22
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.65 - .70
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.25	1.15 - 1.35	1.50 -......
Benzidine base, bbl.	lb.	.70 - .72	.70 - .75	.78 - .80
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.58 - .60	.75 - .85
Benzyl chloride, tech, dr	lb.	.25 - .26	.25 - .26	.35 - .36
Benzol, 90%, tanks, works	gal.	.24 - .25	.25 - .28	.23 - .24
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.24 - .25
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.23 - .25
Cresylic acid, 97%, dr., wks	gal.	.57 - .60	.59 - .63	.53 - .55
Diethylaniline, dr	lb.	.58 - .60	.58 - .60	.59 - .61
Dinitrophenol, bbl.	lb.	.31 - .35	.31 - .33	.35 - .38
Dinitrotoluen, bbl	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil, 25% dr	gal.	.28 - .30	.28 - .30	.26 - .28
Diphenylamine, bbl.	lb.	.45 - .47	.48 - .50	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.63 - .65	.70 - .74

Coal-Tar Products—Continued

		Current Price	Last Month	Last Year
Naphthalene, flake, bbl	lb.	$0.05¾-$0.06	$0.05¾-$0.06	$0.05 -$0.05¼
Nitrobenzene, dr	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl	lb.	.52 - .53	.45 - .50	.65 - .67
Para-nitrotoluine, bbl	lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums	lb.	.17 - .19	.17 - .19	.23 - .25
Picric acid, bbl	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr	lb.	3.00 -......	3.00 -......	4.10 - 4.20
R-salt, bbl	lb.	.47 - .50	.40 - .44	.50 - .55
Resorcinal, tech, kegs	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w., tanks	gal.	.35 -......	.35 -......	.35 -......
Tolidine, bbl	lb.	.95 - .95	.95 - .96	1.00 - 1.05
Toluene, tanks, works	gal.	.35 -......	.35 -......	.26 -......
Xylene, com., tanks	gal	.36 - .41	.36 - .41	.31 -......

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl	ton	$23.00-$25.00	$23.00-$25.00	$20.00-$22.00
Casein, tech., bbl	lb.	.15 - .16	.15 - .16	.13 - .14
China clay, powd., f.o.b. Va.	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Imported, powd	ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .08½	.08 - .08½	.07 - .07½
Prussian blue, bbl	lb.	.33 - .34	.33 - .34	.34 - .36
Ultramine blue, bbl	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl	lb.	.27 - .31	.28 - .30	.27 - .29
Carmine red, tins	lb.	5.00 - 5.10	5.00 - 5.10	4.50 - 4.75
Para toner	lb.	.80 - .90	.80 - .90	.90 - .95
Vermilion, English, bbl	lb.	1.50 - 1.55	1.50 - 1.55	1.35 - 1.40
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17½- .18	.18 - .19
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.50 - 6.50	6.00 - 6.50	5.50 - 6.00
Graphite, Ceylon, lump, bbl	lb.	.07 - .09½	.07 - .09½	.08½- .09
Gum copal, Congo, bags	lb.	.09¾- .10	.09¾- .10	.08 - .10
Manila, bags	lb.	.15 - .18	.15 - .16	.14 - .16
Damar, Batavia, cases	lb.	.25 - .25½	.25 - .26	.28½- .28¾
Kauri, No. 1 cases	lb.	.55 - .57	.57 - .65	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc	ton	44.00 -......	44.00 -......	40.00 -41.00
Pumice stone, lump, bbl	lb.	.05 - .07	.05 - .08	.06 - .08
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H	bbl.	12.25 -......	12.50 -......	14.50 -......
Turpentine	gal.	.88 -......	.88 -......	1.10 -......
Shellac, orange, fine, bags	lb.	.48 - .49	.45 - .47	.72 - .73
Bleached, bonedry, bags	lb.	.53 - .54	.53 - .54	.59 - .62
T. N. bags	lb.	.44 - .45	.43 - .45	.48 - .49
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)	ton	11.00 -......	11.00 -......	10.50 -......
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)	ton	14.75 -......	14.75 -......	14.75 -.....1
Wax, Bayberry, bbl	lb.	.25 - .26	.28 - .30	.20 - .21
Beeswax, ref., light	lb.	.45 - .46	.47 - .48	.40 - .42
Candelilla, bags	lb.	.34 - .35	.34 - .35	.30 - .31
Carnauba, No. 1, bags	lb.	.70 - .72	.70 - .72	.37 - .38
Paraffine, crude 105-110 m.p.	lb.	.05¾- .06	.06 - .06¼	.06 -......

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-......	$200.00-......	$200.00-......
Ferrochromium, 1-2%	lb.	.23- .25	.23- .35	.24-......
Ferromanganese, 78-82%	ton	88.00-90.00	88.00-90.00	115.00-......
Spiegeleisen, 19-21%	ton	32.00-34.00	32.00-34.00	32.00-......
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	33.00-38.00
Ferrotungsten, 70-80%	lb.	1.00- 1.05	.95- 1.15	1.14-......
Ferro-uranium, 35-50%	lb.	4.50-......	4.50-......	4.50-......
Ferrovanadium, 30-40%	lb.	3.40- 4.00	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.13¾-......	$0.13¾-......	$0.14 -$0.14¼
Aluminum, 96-99%	lb.	.27 - .28	.27 - .28	.28 - .29
Antimony, Chin. and Jap.	lb.	.13¾-......	.13¾- .13¼	.20½-......
Nickel, 99%	lb.	.35 -......	.35 -......	.34 -......
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.67 -......	.68½-......	.63½-......
Lead, New York, spot	lb.	7.65 -......	7.90 -......	.09¼-......
Zinc, New York, spot	lb.	7.10 -......	7.35 -......	.09½-......
Silver, commercial	oz.	.55¾-......	.53¾-......	.69½-......
Cadmium	lb.	.60 -......	.60 -......	.60 -......
Bismuth, 500-lb. lots	lb.	2.70 - 2.75	2.70 - 2.75	2.65 - 2.70
Cobalt	lb.	2.50 -......	2.50 -......	2.50 - 3.00
Magnesium, ingots, 99%	lb.	1.00 - .80	.75 - .80	1.00 -......
Platinum, ref	oz.	112.00-......	112.00-......	120.00-......
Palladium, ref.	oz.	68.00- 70.00	68.00- 69.00	78.00-......
Mercury, flask	75 lb.	101.00-......	98.00-......	91.00-......
Tungsten powder	lb.	1.05- 1.15	1.05-......	1.20-......

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	21.00- 24.00	22.50- 24.00	18.50- 24.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	4.75- 5.00
Fluorspar, gravel, f.o.b. Ill.	ton	18.00-......	18.00-......	17.50- 18.50
Ilmenite, 52% TiO_2, Va.	lb.	.0⅜- .0¾	.01½-......	.01½-......
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.28 - .30	.35 - .36	.42 - .43
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.50 - .55	.60- .70
Monazite, 6% of ThO_2	ton	120.00-......	120.00-......	120.00-......
Pyrites, Span. fines, c.i.f.	unit	.13½-......	.13½-......	.11½- .12
Rutile, 94-96% TiO_2	lb.	.12 - .15	.12 - .15	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	11.00 -11.25	12.50 -13.00	9.50 - 9.75
Vanadium ore, per lb. V_2O_5	lb.	.25 - .28	.30 - .35	1.00 - 1.27
Zircon, 99%	lb.	.03 -......	.03 -......	.06 - .05

Patents Issued Dec. 7, 1926, to Jan. 4, 1927

Paper, Pulp and Sugar

Process for Producing High-Grade Half-Stuff. Herman Wenzl, Frankfort-on-the-Main-Sud, Germany, assignor to the Firm I. G. Farbenindustrie-Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,611,-969.

Process of Pulping Raw Cellulosic Material. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,610,323.

Process of Pretreating Wood Chips in the Production of Soda Cellulose. Erik Ludvig Rinman, Djursholm, Sweden.—1,609,832.

Treatment of Cellulose Hydrate. Charles Frederick Cross, London, England.—1,611,001.

Fiber Board and the Manufacture of Same. Joseph R. Coolidge, 3d, Brookline, Mass., assignor to Montan, Inc., Boston, Mass.—1,609,642.

Rubber and Synthetic Plastics

Vulcanization of Caoutchouc. Clayton W. Bedford, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y., a Corporation of New York, and The Goodyear Tire and Rubber Company, Akron, Ohio.—1,613,572.

Vulcanization of Caoutchouc. Clayton W. Bedford, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y., a Corporation of New York, and The Goodyear Tire & Rubber Company, Akron, Ohio.—1,613,573.

Vulcanization of Caoutchouc. Clayton W. Bedford, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y., a Corporation of New York, and The Goodyear Tire & Rubber Company, Akron, Ohio.—1,613,574.

Production of Vulcanized Rubber and Accelerators Therefor. Harold Walter Elley, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,610,216.

Rubber-Latex Coagulum. August H. Peterson, Cumberland, Md., assignor to Kelly-Springfield Tire Company, Cumberland, Md.—1,611,278.

Process for the Manufacture of Dry Well-Preserved Rubber from Latex. Eduard Salomon Ali Cohen, The Hague, Netherlands.—1,610,226.

Process for Mixing Substances with Rubber Latex. Ernest Hopkinson, New York, N. Y., assignor to The Naugatuck Chemical Company, New Haven, Conn.—1,611,349.

Composition of Matter and Method of Producing the Same. Harry L. Fisher, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y.—1,609,806.

Process of Dispersing Bodies In Water. William Beach Pratt, Wellesley, Mass., assignor to Research Incorporated, Boston, Mass.—1,609,308.

Method of Treating Rubber and the Like and the Products Obtained Thereby. James H. Reel, New York, N. Y., assignor to General Rubber Company, New York, N. Y.—1,612,780.

Process of Softening Rubber. Charles P. Hall, Akron, Ohio.—1,611,436.

Composition of Cellulose Ethers and Esters with Hydroscopic Substances and the Method of Producing Them. Camille Dreyfus, Basel, Switzerland, and George W. Miles, Sandwich, Mass., assignor to The American Cellulose & Chemical Mfg. Co., Ltd., New York, N. Y.—1,611,169.

Cellulose-Ester Composition. Robert H. Van Schaack, Jr., Evanston, Ill.—1,612,669.

Cellulose Article and Method of Making the Same. John Feith and John Wesley Ziegler, Kokomo, Ind., assignors to James Clarence Patten, Kokomo, Ind.—1,611,175.

Process of Making Acylated Cellulose Ethers. Walter Hamis Glover, Bedford, and Emile Van Weyenbergh, Coventry, England, assignors to Courtaulds Limited, England.—1,613,451.

Method of Plasticizing Phenolic Molding Materials. Frank P. Brock, Evanston, Ill., assignor to Bakelite Corporation, New York, N. Y.—1,609,506.

Process for Making Phenol Resins and Products Thereof. Carl Kulas and Curt Pauling, Leipzig-Lindenau, Germany, assignors to said Kulas, Leipzig, Germany.—1,609,367.

Petroleum Refining

Fractional Distillation. Richard B. Chillas, Jr., Philadelphia, Pa., assignor to The Atlantic Refining Company, Philadelphia, Pa.—1,612,572.

Art of Distilling Oils. Frank Atherton Howard Elizabeth, N. J., assignor to Standard Development Company.—1,612,289.

Process of and Apparatus for Converting High-Boiling Oils or Hydrocarbons Into Stable Low-Boiling Oils or Hydrocarbons. Donald Lee Thomas, New York, N. Y.—1,611,615.

Process of and Apparatus for Refining Oils. Charles Walcott Stratford, San Francisco, Calif.—1,613,298.

Apparatus for Treating Hydrocarbons. Julius Edward Kobernik, Fullerton, Calif., assignor to Newton Process Manufacturing Co., Fullerton, Calif.—1,613,352.

Oil-Still. John E. Bell, deceased, late of Brooklyn, N. Y.; by Lola R. Bell, executrix, Brooklyn, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,613,306.

Apparatus for Treating Hydrocarbon Oils. John P. Persch, Houston, Tex., assignor to Martha E. Persch, Houston, Tex.—1,611,669.

Apparatus for Petroleum Refining. Carlyle Jefferson, New York, N. Y., assignor to The Griscom-Russell Company, New York, N. Y.—1,609,822.

Process of Cracking Oil. Charles Owens,

Chattanooga, Tenn.—1,613,124.

Process of and Apparatus for Distilling Hydrocarbons Under Pressure. Francis M. Hess, Whiting, Ind.—1,610,523.

Process and Apparatus for the Condensation of Vapors. David G. Brandt, Westfield, N. J., assignor to Doherty Research Company, New York, N. Y.—1,613,016.

Dehydrating Oil. John Primrose, Richmond, N. Y., assignor to Power Specialty Company, New York, N. Y.—1,611,370.

Process of Revivifying Fuller's Earth. Leon A. Tarbox, Oil City, Pa., assignor to Emlenton Refining Company, Emlenton, Pa.—1,613,299.

Process of Separating Water from Emulsions. Ford W. Harris, Los Angeles, Calif., assignor to Petroleum Rectifying Company of California, Los Angeles, Calif. —1,609,546.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, Mo., assignor to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,612,180.

Process for Desulphurizing Unsaturate and Waste Oils and Their Conversion Into Saturate Hydrocarbons. James A. Bishop, Denver, Colo.—1,610,242.

Fuels, Furnaces and Refractories

Kiln. Boyd M. Johnson, Metuchen, N. J., assignor to The Carborundum Company, Niagara Falls, N. Y.—1,612,127.

Process for the Complete Gasification of Bituminous Fuels in Alternately-Operated Generators. Hugo Strache, Vienna, Austria. —1,611,842.

Process of Making Fuel Bricks. Rudolf Tormin, Dusseldorf, Germany.—1,611,616.

Spall Kiln and Process of Burning Lime Therein. Wilburt Ward, Ste. Genevieve, Mo.—1,610,906.

Coking Retort Oven. Joseph van Ackeren, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,613,068.

Process for the Destructive Distillation of Vinasses. Gaston Philippe Guignard, deceased, late of Melun, France, by Leonie Guignard, née Brossier, and Claude André Guignard, administrators, Melun, France.—1,609,712.

Organic Processes

Vat Dyestuffs of the 2-Thionaphthene-2-Indolindigo Series. Richard Herz, Frankfort-on-the-Main, and Jens Müller, Hanau-on-the-Main, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y. —1,613,275.

Production of Vat Dyestuffs. Donald G. Rogers, Buffalo, N. Y., assignor to National Aniline & Chemical Company, Inc., New York, N. Y.—1,609,965.

Vat Dyes and Process of Producing the Same. Hermann Wagner, Soden-am-Taunus, Rudolf Brune, Hochst-on-the-Main, Max Hessenland, Koenigsberg, and Erwin Hoffa and Fritz Müller, Hochst-on-the-Main, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,610,539.

Polyazo Dyes and Process of Making Same. Emmet F. Hitch, Wilmington, Del., and Francis H. Smith, Woodstown, N. J., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,610,946.

Manufacture of Yellow Azo-Dyestuffs. August Dorrer, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,610,936.

Direct Blue Disazo Dyestuff. Pio Caccia, New York, N. Y.—1,609,793.

Manufacture of Sulphur Dyestuffs. Johannes Wutke, Wolfen Kreis Bitterfeld, and Walter Hagge, Dessau-in-Anhalt, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,609,927.

Manufacture of Lead Alkyl Compounds. Frederick W. Sullivan, Jr., and Lyman Chalkley, Jr., Whiting, Ind., assignors to Standard Oil Company, Whiting.—1,611,695.

Making Metallo-Organic Compounds. Charles A. Kraus and Conral C. Callis, Worcester, Mass., assignors to Standard Development Company.—1,612,131.

Compound of Silver Iodide and Protein Substances. Thorn Smith, Detroit, Mich., assignor to Parke, Davis & Company, Detroit, Mich.—1,610,391.

Solution of Arsenobenzene Derivatives. George W. Raiziss and Abraham Kremens, Philadelphia, Pa., assignors to Abbott Laboratories, Chicago, Ill.—1,609,960.

Process for the Production of Solutions of Mercury Derivatives of Hydroxy-Sulpho-Benzoic Acids. Eugen Sági, Bratislava, Czechoslovakia, assignor to Chemosan Aktiengesellschaft, Vienna, Austria.—1,613,569.

Manufacture of Sugar Derivatives of 3.3'-Diamino-4.4' - Dihydroxyarseno - Benzene. Leonard Anderson, Nottingham, England, assignor to Boots Pure Drug Company Limited, Nottingham, England.—1,612,598.

Process for Preparing 1-4-5-8 Naphthalene Tetracarboxylic Acid. Wilhelm Eckert, Hochst-on-the-Main, Germany, assignor to Grasselli Dyestuffs Corporation, New York, N. Y.—1,612,103.

Process for the Recovery of Camphor and Naphthalene Contained in Gaseous Mixtures. Jean Henry Brégeat, Paris, France, assignor to Brégeat Corporation of America, Wilmington, Del.—1,613,218.

Catalyst for Synthetic Methanol Production. John C. Woodruff and Grover Bloomfield, Terre Haute, Ind., assignors to Commercial Solvents Corporation, Terre Haute, Ind.—1,605,593.

Ester of Butyl Alcohol. Robert H. Van Schaack, Jr., Evanston, Ill.—1,613,366.

Preparation of C-C-Normal Butyl Ethyl Barbituric Acid. Edouard Layraud, Paris, France, assignor to Etablissements Poulenc Freres, Paris, France.—1,609,520.

Method of Manufacturing Nitroglycerin-Nitrocellulose Powders. Leopoldo Parodi-Delfino, Rome, Italy.—1,609,303.

Process of Making Nitrogen Containing Derivatives of Terpene Alcohols. Richard Wolffenstein, Berlin-Dahlem, Germany.—1,611,978.

Dinitrobenzene Pellet. Alling P. Beardsley, Plainfield, and Carl E. Mensing, Somerville, N. J., assignors to The Calco Chemical Company, Boundbrook, N. J.—1,612,167.

Manufacture of Sodium Salt of 3.3'-Diamino-4.4'-Dihydroxyarsenobenzene. P. A. Kober, Hastings-on-Hudson, N. Y.—1,611,461.

Production of Metaldehyde. Theodor Lichtenhahn, Visp, and Emil Lüscher and Heinrich Steiger, Basel, Switzerland, assignors to the Firm Elektrizitätswerk Lonza, Gampel, Switzerland.—1,612,032.

Method of Manufacturing Fatty Acids. Adolf Welter, Krefeld-Rheinhafen, Germany.—1,612,682.

Inorganic Processes

Ammonium-Nitrate Explosive. Ernest M. Symmes, Wilmington, Del., assignor to Hercules Powder Company, Wilmington, Del.—1,613,335.

Granular Ammonium Nitrate and Process of Making Same. Ernest M. Symmes, Wilmington, Del., assignor to Hercules Powder Company, Wilmington, Del.—1,613,334.

Process for the Removal of Borax from Alkali-Metal Nitrates. Charles F. Booth, Anniston, Ala., and Paul Logue, St. Louis, Mo., assignors to Federal Phosphorus Company, Birmingham, Ala.—1,610,485.

Method of Producing Nitrogen-Hydrogen Mixture for the Synthetic Production of Ammonia. Frederick W. de Jahn, New York, N. Y., assignor to Atmospheric Nitrogen Corporation, Solvay, N. Y.—1,610,076.

Synthetic Production of Ammonia. Chester Mott, Denver, Colo., assignor to Compressed Gas Corporation, Denver, Colo. —1,611,359.

Method of Preparing Substituted Cyanamides. John L. Osborne, Elizabeth, N. J., and George Barsky, New York, N. Y., assignors to American Cyanamid Company, New York, N. Y.—1,611,941.

Process for the Production of Hydrocyanic Acid. Georg Bredig and Egon Elöd, Karlsruhe, Germany, assignors to the Firm of Rudolph Koepp & Co., Oestrich-on-the-Rhine, Germany, a Society organized under laws of Germany.—1,610,035.

Process for producing Cyanic Combinations. Otto Stalhane, Stockholm, Sweden. —1,610,897.

Process for the manufacture of Sodium Bicarbonate and the production of Nitrogen. Edward E. Arnold, Conventry, R. I., assignor to The Nitrogen Corporation, Providence, R. I.—1,611,401.

Process and apparatus for the manufacture and production of chemically-pure Sulphuric Acid. Max Krafft, Hruschau, Czechoslovakia.—1,611,534.

Process of producing Hydrated Lime. William E. Carson, Riverton, Va. — 1,613,341.

Production of Anhydrous Hydrosulphites. Lloyd K. Riggs, New Brunswick, N. J., assignor to E. R. Squibb and Sons, New York, N. Y.—1,609,773.

Process of producing Calcium Arsenate. Edward A. Taylor, Cleveland, Ohio, assignor to The Grasselli Chemical Company, Cleveland, Ohio.—1,612,233.

Method of Treating Alunite. Herbert H. Meyers, Pittsburgh, Pa., assignor to Armour Fertilizer Works, Chicago, Ill.—1,613,238.

Production of Titanium Oxide. Philip Alexander Mackay, London, England, assignor to National Metal and Chemical Bank Limited, London, England.—1,613,234.

Production of Sodium Sulphide. Horace Freeman, Shawinigan Falls, Quebec, Canada, assignor of one-half to Canada Carbide Company, Limited, Montreal, Canada.—1,609,615.

Process for Producing Tungsten and Molybdenum Carbide in Lumps of Various Sizes. Hugo Lohmann, Berlin-Johannisthal, Germany.—1,610,061.

Method of Making Ferrophosphorus. Edward V. Rawn, Hopkinsville, Ky.—1,613,125.

Process of Producing Oxygen and Ammonia. Chester Mott, Denver, Colo., assignor to Compressed Gas Corporation, Denver, Colo.—1,613,405.

Method of Making Zirconium Compounds. Charles J. Kinzie, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Company, New York, N. Y.—1,609,826.

Chemical Engineering Equipment and Processes

Apparatus for the Evaporation of Liquid Chlorine. James H. MacMahon, Niagara Falls, N. Y., assignor to The Mathieson Alkali Works, Inc., New York, N. Y.—1,609,756.

Manufacture of Hypochlorites. Maurice C. Taylor, Niagara Falls, N. Y., assignor to The Mathieson Alkali Works, Inc., New York, N. Y.—1,609,328.

Process and Apparatus for Preparing Bleach Liquors. James H. MacMahon, Niagara Falls, N. Y., assignor to The Mathieson Alkali Works, New York, N. Y. —1,609,758.

Clarification of Bleach Liquors. James Douglas MacMahon, Niagara Falls, N. Y., assignor to The Mathieson Alkali Works, New York, N. Y.—1,609,759.

Apparatus for Chlorinating Solutions. James H. MacMahon, Niagara Falls, N. Y., assignor to The Mathieson Alkali Works, Inc., New York, N. Y.—1,609,757.

Method and Apparatus for Manufacturing Glass. John I. Arbogast, Pittsburgh, Pa.—1,611,328.

Process for the Manufacture of Articles in Silica Glass. Henri George, Paris, France, assignor to Société Anonyme Quartz & Silice, Paris, France.—1,612,628.

Apparatus for Making Glass. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company.—1,610,377.

Glass Composition. William Chittenden Taylor, Corning, N. Y., assignor to Corning Glass Works, New York, N. Y.—1,609,329.

Siliceous Composition of Matter. Herbert A. Endres, Lompoc, and Lyle Caldwell, Los Angeles, Calif., assignors to The Celite Company, Los Angeles, Calif.—1,613,448.

Method of Making Brick and Other Burned-Clay Products. Poole Maynard, Atlanta, Ga.—1,609,416.

Fused Quartz Product and Process of Producing Same. Elihu Thomson, Swampscott, Mass.—1,610,182.

Sulphur Composition. William Hoffman Kobbé, New York, N. Y., assignor to Texas Gulf Sulphur Company, Bay City, Tex.—1,612,869.

Sulphur Material. Harry A. Noyes, Greenwich, Conn., assignor to Texas Gulf Sulphur Company, Bay City, Tex.—1,611,939.

Evaporator. Gustav Nicolai, New York, N. Y.—1,611,059.

Evaporating Apparatus. Walter L. Badger, Ann Arbor, Mich., assignor to Swenson Evaporator Company, Harvey, Ill.—1,612,961.

Process of Evaporation. Walter L. Badger, Ann Harbor, Mich., assignor to Swenson Evaporator Co., Chicago, Ill.—1,609,853.

Process of Absorbing Sulphur Trioxide from Gases Containing Same. James H. Shapleigh, Dover, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,608,006.

Apparatus for Preparing Supersaturated Solutions. Alexander M. Shook, Toronto, Ontario, Canada, and George R. Hannan, Los Angeles, Calif., assignors to Aquazone Laboratories, Inc., Los Angeles, Calif. —1,608,251.

Absorbent for Liquid Oxygen Explosives. Chester Mott and Henry W. Dahlberg, Denver, Colo., assignors, by mesne assignments, to Purox Company, Denver, Colo.—1,606,889.

Method of Recovering Fats and Oils. Clarence F. Eddy, Norfolk, Va., assignor to Cocoa Products Company of America, Incorporated, Norfolk, Va.—1,607,731.

Method of Treating Raisins and the Like. Thomas W. W. Forrest, Oakland, Calif., assignor to Sun Maid Raisin Growers of California, Fresno, Calif.—1,607,886.

Water Deaeration. George H. Gibson, Montclair, N. J., assignor to Cochrane Corporation, Philadelphia, Pa.—1,607,070.

Art of Destructive Distillation. Otto H. L. Wernicke, Gull Point, Fla.—1,607,328.

Heat Exchanger. Charles F. Richey and Paul Y. Duffee, Franklin, Pa., assignors, by mesne assignments, to The Motor Fuel Corporation, Franklin, Pa.—1,605,987.